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EDITORIALS

THE NATIONAL RESEARCH COUNCIL.

The National Academy of Sciences, at the request of President Wilson, appointed a National Research Council, with the object of co-ordinating the research work of the country to the end of securing the greatest results from the standpoint of national welfare. While from the nature of the case the research work of commercial industrial laboratories must generally be carried on in secret and will frequently involve duplication of effort, this is not true of the investigations made at educational institutions, where different fields of research may well be occupied by different workers. Thus in astronomical work much has already been done in dividing up the work of observation among different observatories and in leaving to certain observatories problems which they are best equipped to investigate. Announcement by one investigator of the inauguration of a specified line of work enables others to avoid the duplication of effort and apparatus involved in attacking the same problem.

Arrangements have now been made by which The Engineering Foundation has placed its resources at the disposal of the Research Council, and this should greatly facilitate the achievement of practical results along the lines desired by the Council. The Council includes in its membership the directors of many noted research laboratories, such as the Rockefeller Institute, the Mount Wilson Solar Observatory and the Bureau of Standards, and many men noted for their individual research work. Electrical science and industry are well represented by Dr. W. R. Whitney and Mr. C. E. Skinner, the directors of the General Electric and Westinghouse research departments; by Prof. M. I. Pupin; and by three past-presidents of the American Institute of Electrical Engineers, Dr. Elihu Thomson, Mr. Gano Dunn and Dr. John J. Carty.

This organization should be of value through the assistance it can render the Government in connection with military and other national problems as they arise, by the stimulus which it can offer to the application industrially of the results of research, and by the opportunities which it will have of impressing upon the executives of industrial corporations the great benefits which might accrue through the application of research methods to their individual problems. These results should be by-products of its general direction and co-ordination of scientific research and such assistance to industrial research as it may find it feasible to offer. The encouragement of research, both in pure science and its application, is a vital element in the maintenance of our position as a nation in the industrial and manufacturing world. European nations have had the realization of this fact forcibly inpressed upon them by their experiences during the present war.

PLANNING FOR SUBSTATION EXPANSION.

It would seem needless to call attention to the importance of looking toward future developments when designing a substation, were it not for the fact that now and then one runs across installations in which expansion has apparently been the last thing in the mind of the engineer laying out the work. Obviously no standard layout can be recommended for all cases, and there is still room for a good deal of study along the line of comparing the relative fixed and operating costs of different designs. In some locations land values prohibit expansion along horizontal lines, but these are offset by the frequent installations on cheap real estate unhampered by "close-fitting" abutters. Whatever the local situation, the chances of future development ought to receive consideration, and if analysis dictates no provision for expansion *in situ,* well and good.

Oftener, however, the designing engineer faces the probability of a substantial growth of business. The problem then becomes an exceedingly interesting puzzle of checks and balances, if local restrictions press. On the whole, provision for expansion along symmetrical lines is desirable, even facing the fact that equipment is in process of evolution and bearing in mind that the unit of five years hence may not duplicate that initially set down. It is a good plan to provide space enough in the line of natural development to permit the installation of equipment of even larger size than that first utilized. For example, good engineering provides, when possible. enough room for additional feeder regulators and their necessary wiring to enable larger future sizes to be installed if the service warrants, without interfering with the initial equipment in any way.

There is a tendency in many cases to locate substation equipment with regard to the compact needs of the present rather than to look far ahead. Efforts to save on building outlay often lead to cramping of apparatus which can be more safely operated with wider spacing between units. Carried to extremes, we find equipment located at close quarters and with dissimilar units in the natural line of advance when developing the installation in future years. Switchboards are put up without proper regard to the clearance which will be demanded by additional panels as related to future motor-generator or rotary-con-

verter sets, and the mistake may be made of putting too much apparatus of different kinds in one line, instead of providing rows which can be extended without interference as the load and output increase. Then, too, the provision of reserve capacity in floor ducts and the location of these with respect to extension of plant, is sometimes handled in a rather haphazard manner. In some cases it pays to install transformers and machinery of initial excess capacity rather than to spend large sums for unused substation space. Computations along the line of determining the best plans will help to realize satisfactory solutions and give the substation owner the maximum capacity and efficiency of service feasible for a given outlay.

VALUE OF SERVICE INSPECTION ON THE PREMISES OF CUSTOMERS.

Nearly every one who has considered the subject of electrical inspection has felt that while the greatest need is in inspecting new construction work, there is also desired frequent re-inspection of the premises where electricity is used. The reason such inspection has not been undertaken is chiefly on account of the limited appropriation available for inspection work both by cities and by underwriters' organizations. In some quarters it has been advocated that such re-inspection could very appropriately be undertaken by central stations and instances in which such inspection has been found to give very satisfactory results are recorded in this issue.

It is true that the inspections undertaken by central stations are not primarily for the purpose of seeing that added wiring or re-arrangements of circuits conform strictly with the requirements of the National Electrical Code or special local regulations. However, although undertaken for a different purpose, they do have considerable value in improving the character of the installation and thereby minimizing the hazards that may exist from improvised wiring put in by the consumer himself or by some one who may pass as an electrician.

The greatest immediate benefit resulting from such inspection, where it is undertaken gratis by the central station and includes the free repair of minor defects of sockets, switches, plugs, etc., is in putting back into commission circuits, lamps and appliances which have been allowed to fall into disuse through lack of proper attention. That this amounts to a considerable percentage of the possible connected load has been shown in a number of instances; in fact the load that has been added by restoring lamps and appliances to active use has in several cases more than paid for the cost of making the inspection. Another important benefit to the central station is in the good will it develops among its customers, who are compelled to realize the company is trying to look after their interests so that the service it renders will be maintained to the standard that should prevail. When such inspection and repair work is undertaken the inspector can almost invariably make valuable suggestions in the way of giving information as to the utility and low cost of many electrical appliances. This has been found to pave the way for numerous sales of devices, although the men themselves make no sales whatever and are specifically instructed not to give the impression that they are solicitors or promoters of the use of appliances.

Another feature of this work which could be developed to advantage is to have the inspectors make suggestions as to the manner in which lighting equipment can be used to the best advantage. This has been done in some cases, but unless the inspector has received some instruction in the matter of modern lighting practice he is apt to make suggestions that do not conform to the most approved practice. There is no question but that such service is appreciated by customers if it is provided through men of considerable tact. Such men should be especially trained for the work, and in turn the experience they receive serves to give them excellent training for subsequent work as a regular solicitor.

While this special inspection service is best adapted to small cities, it may also be extended to many large cities. It has been found to work out most advantageously in the case of syndicate plants, the men going from one city to another on periodical rounds. No central station, however, should neglect the possibility which this policy offers of increasing the good will among its customers and also maintaining its residence load up to the point which it may be made to attain.

EXCESS SEASONABLE RATES SUSTAINED IN PRINCIPLE.

In an extended statement issued September 28 the Maine Public Utilities Commission declared that the use of seasonable excess rates at Bar Harbor by the Bar Harbor & Union River Power Company is not discriminatory in principle, although the charges for local lighting service are 25 cents per kilowatt-hour for summer users against 15 cents for yearly consumers. This case has attracted no little attention on account of the celebrated watering place involved, and the statement of principles by the board in its finding is of much interest with respect to several points of wide application.

The reasonableness of the rates was not determined by the Commission and remains to be decided pending a valuation of the property. That part of the problem, however, is largely a question of arithmetic, and the chief interest of the Bar Harbor case lies in the relations existing between the cost of serving yearly and seasonable customers. From unchallenged evidence presented by the company it appeared that the maximum demand of the Bar Harbor District in the three years ended June 30, 1916, was 560 kilowatts, the maximum non-summer demand being 210 kilowatts. The total cost of supplying the seasonal service, including both fixed and operating expenses, was $101,639 (service used, 435,882 kilowatt-hours), and the total cost of supplying the yearly service (705,068 kilowatt-hours) was $83,950. On this basis the unit cost of the seasonal service is almost twice that of the yearly sup-

ply, which might be expected in view of the discrepancy between the winter and summer peaks.

Bar Harbor is a community to which principles of rate-making applicable to summer resorts generally may fairly apply. The higher rate is in effect from May 1 to November 1, indicating the length of the present season away from town, and the low maximum demand from the standpoint of modern power requirements is an eloquent tribute to the economies of the tungsten lamp. One or more persons who retain a voting residence in Bar Harbor and live elsewhere outside the summer season claimed that they should have the yearly rate because they are residents of the town, but the Commission held that when it is understood that the seasonal rate is based upon the nature of the use of the product or service charged for and not upon the residence of the user, it will be seen that this objection is not tenable. It was alleged that one person who owned two houses, one used only in the summer and the other throughout the year, paid the seasonal rate for one and the yearly rate for the other. This furnishes no ground for discrimination, in the Commission's opinion, for the rate schedules apply without regard to ownership.

In this case the complainants offered considerable evidence to show that the season-rate principle was not applied to stores and hotels and claimed that this was unfair to householders. In reply the company maintained that the stores at Bar Harbor usually were not open evenings and used energy only in the afternoon, during off-peak hours. It was also emphasized by the company that the hotels used a much larger percentage of their maximum demand than do dwelling houses. Without passing upon these local differentials the Commission took occasion to emphasize the justice of seasonal differentials, comparing the necessity of obtaining sufficient rental for summer cottages to cover a year's fixed charges with the corresponding necessity in relation to the central-station investment. The Commission received some local press editorial criticism on the score of the technicality of its findings, but to the public-utility manager with a taste for clear-cut computations, the decision must appear exceptionally logical and straightforward.

A CENTURY OF LIGHT.

Under this title Dr. Walton Clark, president of the Franklin Institute, presents a very interesting article in the October issue of the *Journal of the Franklin Institute*. Dr. Clark has investigated the conditions and the cost of illumination for the past century, paying particular attention to the situation in the city of Philadelphia. A century ago sperm oil and tallow candles were the principle illuminants in use, and both of these have become obsolete to such an extent that it would be difficult now to find them on sale. About the middle of the last century kerosene was utilized, at a cost of 80 cents per gallon, and with its introduction, followed by the more general use of coal gas, the use of candles gradually became superseded.

The cost of 1,000 candle-hours of light a century ago was about $2.50. The coming of kerosene brought the price below $2.00, but it was not until the latter half of the nineteenth century that this amount of light could be obtained for less than $1.00. With the cheapening of both kerosene and gas the cost was reduced in the latter quarter of the century to less than 50 cents, while at the present time, owing to the high efficiency of the gas mantle and to the introduction of modern electric illuminants, the cost is in the neighborhood of 10 cents per 1,000 candle-hours, or one twenty-fifth of the original cost, measured by a shrinking dollar. These figures are for the cost of energy or fuel alone and apply to household conditions. The cost of electrical energy for light production is of course much less where energy can be supplied more cheaply and especially where large units are used, and in some cases is less than one cent per 1,000 candle-hours.

The result of this remarkable decline in the cost of illumination during the century has not been to reduce the average bill of the home owner for this purpose to a very remarkable extent, but to supply him with a superior quantity and quality of illumination. Dr. Clark estimates that the average household today is supplied with 18 times the average illumination of a century ago. No other necessity of household use has been so cheapened and improved during the century. Combined with this great improvement in general household illumination the cost per family has, however, probably been reduced by about one-third.

Exterior or street lighting has pursued a somewhat similar course. A century ago the annual cost for street lighting in the city of Philadelphia was approximately $20,000, or about 33 cents per capita, but the approximate cost per 1,000 candle-hours was 57 cents. At the present time that city spends nearly $2,400,000 annually for street lighting, or about $1.35 per capita, but the cost per 1,000 candle-hours is only 3.5 cents. While the population of the city was increasing to 30 times the former value, the amount of street lighting increased by 2,000 times.

While the cost of gas has, of course, decreased and the use of the gas mantle has greatly increased the efficiency of its application to illumination, it is to the introduction and improvement of electric lamps that the general use of improved lighting in cities is largely due. The third of a century of the application of electric illuminants has witnessed a steady decline in the cost of electrical energy and a still more rapid decline in the cost of illumination, due to the remarkable improvements which have taken place in the efficiency of conversion of electrical energy into useful radiant energy. For the future we may expect further reductions in the cost of energy and some slight improvements at least in the efficiency of its conversion into light, but the most marked change in the conditions of household illumination is likely to be in the improvement of the methods of utilization of the light which is already so cheaply supplied.

Happenings in the Industry

Electrical Jobbers Consider Industry Problems—Empire State Association Meets—Competition for Electrical Inventions—Excess Summer Rates Upheld by Commission—Engineers Help Organize Research Council—July Electrical Exports—Electrical Manufacturers Form Carbon Section—Local Plans for America's Electrical Week

Electrical Jobbers Consider Problems of the Industry at Cleveland Meeting.

The Cleveland meeting of the Electrical Supply Jobbers' Association at the Hotel Statler on October 10 to 12 was marked by a strong determination to meet the perplexing problems which confront the industry. The unequalled prosperity which is being enjoyed has created a condition of supply and demand which is unique in the history of the Association and which obviously calls for earnest consideration. That conditions are unusual was demonstrated by the large attendance from all sections of the country, a particularly noteworthy feature being a full attendance of Chicago members.

Secretary Franklin Overbagh presided at the sessions which were held on the morning and afternoon of Tuesday and Wednesday, with a morning session on Thursday and an executive session on Wednesday evening. The first day was occupied largely with a discussion of new by-laws for the Association, which propose dividing the membership into various geographic groups which will meet at periodic intervals to discuss local problems. The number of national meetings, by the provision of the new by-laws, would be reduced to two or three. Other features of the new by-laws pledge the Association to work for maintaining the standards of electrical goods and to encourage the fullest co-operation between the various branches of the industry.

Empire State Gas and Electric Association Meets.

The effectiveness of intensive methods was again demonstrated at the annual meeting of the Empire State Gas and Electric Association, held October 5 and 6 in the Engineering Societies Building, New York City. The idea of taking up only a few subjects and considering them thoroughly, while not unique with this society, is one of the features making for its success. Only three papers were presented at the four sessions, these having to do with extensions, taxation and insurance. As a preliminary to the meeting there was a golf tournament on October 4 at the Country Club of Glen Ridge, N. J., at which E. H. Rosenquest and J. M. Butler won the principal prizes. H. L. Snyder, of Long Island City, had charge of this affair.

The first session on Thursday was taken up with routine business and at the second Carl H. Graf, of Albany, presented quite a lengthy paper on "Extensions." This is always a live subject and the method of handling seems to vary with each property. A simple method for figuring gas extensions, based upon the estimated annual consumption, was given by H. W. Peck, of Schenectady, where the company will lay five feet of extension for each 1,000 cubic feet of annual consumption. Others entering into the discussion were W. J. Clark, Westchester Lighting Company; H. M. Beugler, Central Hudson Gas & Electric Company, and A. D. Dudley, of Syracuse. A topical discussion on profit sharing and bonus systems completed the first day's program.

The attendance and participation of the engineers of the Public Service Commissions at Empire State meetings is the rule and Wm. McClellan, formerly one of the upstate commissioners, and W. A. Leonard and E. J. Cheney, commission engineers, were in evidence. "Taxation" was the subject handled by Paul Shipman Andrews, and "Accident Risks" was the topic presented by C. E. Morrison at the second day's sessions. The election of officers resulted as follows:

President, Stuart Wilder, Westchester Lighting Company, Mt. Vernon; vice-presidents, H. M. Beugler, Central Hudson Gas & Electric Company, Poughkeepsie, and H. W. Peck, Schenectady Iillminating Company, Schenectady; treasurer, C. A. Graves, Southern New York Power Company, Utica; secretary, C. H. B. Chapin, 29 West Thirty-ninth Street, New York City.

The Executive Committee consists of J. C. De Long, C. G. M. Thomas, F. H. Hill, A. B. Tenney, M. J. Brayton, E. H. Rosenquest and S. J. Magee

Competition Arranged for Uncommercialized Electrical Inventions.

For the purpose of fostering the development of uncommercialized inventions in the electrical field a prize competition was arranged in connection with the Electrical Exposition and Motor Show at New York City. All electrical inventions which have not been commercialized were eligible, and three prizes awarded. The competition closed October 13, and participants were required to present a working or other model which will show the actual operation of their inventions.

In announcing the competition, President Arthur Williams, of the Electrical Exposition, said: "I believe that there are many valuable inventions in the electrical field, the brain-children of future Thomas A. Edisons, which are virtually shelved because of the lack of an opportunity to present them. Our purpose is to discover and foster these. All inventions that are worthy will be properly brought to the attention of those interested in their development. In arranging this competition we have been influenced by the fact that many of the famous inventions which have contributed so much to electrical development had lain dormant for varying periods, and the progress of the modern world delayed correspondingly. Thomas A. Edison is among those who were greatly handicapped at the start, through lack of an opportunity to secure proper recognition of their valuable inventions."

Maine Commission Upholds Excess Summer Rates.

A decision of importance to central-station interests was rendered by the Maine Public Utilities Commission, September 28, when certain fundamental principles applying to summer residence business were set forth and the lighting company, by implication, justified in charging a rate based on the "readiness-to-serve" principle which made the actual kilowatt-hour price seem to customers excessive, as compared with rates of service to classes of customers using electricity the year around.

Consumers of energy in Bar Harbor, supplied by the Bar Harbor & Union River Power Company, Ellsworth, Me., had complained to the Commission, alleging unreasonable rates, and discrimination as between yearly and sum-

mer lighting rates. The company explained and justified the differences, and submitted a complete plant inventory.

The company showed that the total capacity, or readiness-to-serve, cost for its entire territory is $175,276. The maximum demand of the city of Ellsworth, using energy at about a level volume the year around, was 207 kilowatts, while the maximum for Bar Harbor was 560 for the summer and 210 for the winter, an excess of 350 kilowatts for the summer demand.

Capacity costs, distributed according to these figures, showed that the amount attributable to the Bar Harbor district, due to seasonal demand, was $79,070, and due to yearly demand, $47,442. The variable or output costs during the same period for Bar Harbor were $59,076.

The seasonal service used in Bar Harbor amounted to 435,882 kilowatt-hours, and the yearly service to 705,068 kilowatt-hours, a total of 1,140,950. Apportioning the output cost to actual use, there was chargeable to seasonal use $22,569, and to yearly use $36,508 (cents omitted). The total costs were: Seasonal service, $101,639; yearly service, $83,950.

The deductions show the cost of serving seasonal and yearly customers to be about in accord with the ratio of summer to yearly rates, i. e., 166⅔ to 100, or 25 and 15 cents per kilowatt-hour, respectively.

Other companies in Maine which make increased charges for seasonal over yearly use of energy are the York County Power Company, whose excess charge is 100 per cent; the Penobscot Bay Electric Company, 66 to 100 per cent; Rockland, Thomaston & Camden Street Railway, 66 per cent; Cumberland County Power & Light Company, 58.8 per cent; Vinalhaven Electric Company, 66 per cent.

The Commission neither approves nor disapproves the present rates *per se*, but holds that the schedule is not discriminatory. The case will be retained for further action.

Engineers Combine With Scientists in Organization of National Research Council.

Arrangements have been completed whereby the resources of The Engineering Foundation, under the auspices of the four principal national engineering societies, are placed at the disposal of the National Research Council, which was appointed by the National Academy of Sciences at the request of President Wilson. The object of the Council is to co-ordinate the scientific research work of the country in order to secure efficiency in the solution of national problems. The Council was without funds until The Engineering Foundation, established to further scientific and engineering research, offered to place its resources at the Council's disposal, including the services of its secretary, Cary T. Hutchinson, to act as secretary of the Council. The offer was accepted and plans for immediate activities have been placed in the hands of an executive committee.

The members of the Council are Edwin G. Conklin, Princeton University; A. A. Noyes, Massachusetts Institute of Technology; L. H. Baekeland; A. A. Michelson, of the University of Chicago; M. I. Pupin, of Columbia University; Clemens Herschel, president of the American Society of Civil Engineers; John J. Carty, chief engineer of the American Telephone & Telegraph Company; Gano Dunn, president of the J. G. White Engineering Corporation; C. E. Skinner, of the Westinghouse Electric & Manufacturing Company; W. R. Whitney, director of the research laboratory of the General Electric Company; William Crozier, chief of ordnance of the United States Army; George O. Squier, chief of aviation of the United States Army; David W. Taylor, United States Navy; S. W. Stratton, director of the Bureau of Standards; Van H. Manning, director of the Bureau of Mines; Charles F. Marvin, chief of the United States Weather Bureau; John A. Brashear; W. F. M. Goss, University of Illinois; William H. Holmes; W. W. Keen; E. C. Pickering; Charles F. Rand, president of the United Engineering Society; Theodore W. Richards, Harvard University; R. A. Millikan, University of Chicago; Ambrose Swasey; Elihu Thomson, of the General Electric Company; C. R. Van Hise, president of the American Association for the Advancement of Science; Charles D. Walcott, of the Smithsonian Institution; J. M. Coulter, Princeton University; R. H. Chittenden, Yale University; Raymond Pearl; M. T. Bogert, Columbia University; William H. Welch, president of the National Academy of Sciences; William C. Gorgas, surgeon general of the United States Army; Simon Flexner; Victor C. Vaughan, and George E. Hale, chairman. Other members of the Council will be appointed from time to time as the needs of the work dictate.

Electrical Exports for July Maintain Recent Monthly Averages.

During last July the total value of the electrical exports of the United States maintained the general average of the first half of 1916, although falling below the high totals of May and June. As compared with July of a year ago there was a gain of nearly 40 per cent.

The number of articles shipped are given in the report for only four electrical classes. During last July these were as follows: Electric fans, 2,083; arc lamps, 52; carbon-filament lamps, 38,684; metal-filament lamps, 902,247.

The detailed electrical figures for July and for the corresponding month a year ago are given in the following table:

Articles	July, 1916	July, 1915
Batteries	$ 149,512	$ 91,344
Dynamos and generators	131,597	156,191
Fans	28,395	28,438
Insulated wire and cables	370,378	187,379
Interior wiring supplies, etc. (including fixtures)	82,952	80,933
Lamps—		
Arc	803	433
Carbon-filament	3,738	9,712
Metal-filament	165,132	55,932
Meters and other measuring instruments	46,486	55,463
Motors	409,474	380,934
Telegraph instruments (including wireless apparatus)	23,839	8,536
Telephones	74,162	101,338
Transformers	62,699	72,231
All other	1,444,690	916,662
Total	$2,993,857	$2,146,526

Not included in the foregoing are electric locomotives, which are separately listed. Last July five of these were exported, valued at $13,176.

Lectures on Electrical Engineering Topics to Be Given in New York City.

A number of important courses of free public lectures on electrical subjects will be given in New York City during the school year, under the direction of the Department of Education.

Dr. Ernest R. Von Nardroff, of Stuyvesant High Scool, will deliver 12 lectures on "Electricity, Atoms and the Ether" at the American Museum of Natural History, Manhattan, on successive Saturday evenings, beginning October 7. The second of 12 Monday evening lectures by W. Wallace Ker, of the Hebrew Technical Institute, on "Principles and Practices of Electrical Engineering," was given October 9, at Public School 62, Manhattan. On October 10 Charles L. Harrington began a course of six lectures, given on alternate Tuesday evenings, on "Electricity and Magnetism," at Public School 36, the Bronx.

In Brooklyn, Frederick W. Huntington, of Erasmus Hall High School, will give a course of lectures on "Electricity and Magnetism," at Public School 159, on October 16 and successive alternate Mondays. On alternate Mondays he will repeat the lecture in Queens, at Public School 34.

New Business Committee of Ohio Association Announces Plans for Year's Meetings.

The New-Business Co-operations Committee of the Ohio Electric Light Association held its first meeting in Columbus, September 20. It was decided to hold open meetings in Cincinnati, Toledo, Dayton and Youngstown, during the winter months, the first meeting to be held in Cincinnati, November 8. At this meeting the following subjects will be discussed: "America's Electrical Week," "Promotion of Electrical Merchandise Sales for the Holiday Season," "Electrical and Steam Service for Hotels, Department Stores and Office Buildings."

The committee plans to take up the following subjects during the coming year: "Electric Drive for Ice Making and Operating of Refrigerating Plants," "Motor Application and How to Dispose of Wood Waste in Woodworking Shops" "Industrial Heating," "Electric Furnaces," "Electric Service for Flour Mills and Grain Elevators," "Electric Service for Water Pumping," "House Wiring," "Appliance Sales," "Central-Station Merchandising," "Central-Station Advertising" and "Electric Cooking." During the year it is also intended to have a round-table meeting at which it is proposed to have each member present and give talks concerning unsuccessful ventures. The meeting will probably be entitled "Mistakes We Have Made."

Program for Meeting of Association of Railway Electrical Engineers.

The annual convention of the Association of Railway Electrical Engineers will be held at the Hotel La Salle, Chicago, Ill., October 31 to November 3. The entire nineteenth floor of the hotel has been engaged for the meeting, and space has been provided for the exhibits of about forty manufacturing companies that will participate.

Committee reports will be made on the following: Lighting of railway yards; standardization of train-lighting lamp units; compressed-air appliances; electric welding; maintenance and repair of shop appliances; car-lighting handbook; electric train equipment and standardization of axle generators; locomotive headlights; metal conduit for wiring cars, and standardization of motors for turntables and car transfers.

Associated Manufacturers of Electrical Supplies Organize Carbon Section.

The Board of Governors of the Associated Manufacturers of Electrical Supplies held its first meeting since the summer on Wednesday, September 27, at the offices of the association in New York City. There was a full attendance, and many lines of activities for the different sections were discussed and approved for the coming winter, which promises to be a busy one. There are now fourteen sections organized and in active operation, and the association has practically doubled its membership in the past year.

On September 28, at the Hotel Biltmore, New York, the manufacturers of carbon products held a meeting, at which time a section to be known as the Carbon Section was organized. J. F. Kerlin, of the National Carbon Company, Cleveland, O., was the temporary chairman of the meeting. G. P. Fryling, of the Speer Carbon Company, St. Mary's Pa., was elected permanent secretary of the Section, and H. C. Stackpole, of the Stackpole Carbon Company, St. Mary's, Pa., was elected treasurer. J. F. Kerlin was appointed permanent chairman. Rules governing the Section were adopted, and the following standing committees named: (1) Motor and Generator Brushes. (2) Carbon Electrodes and Specialties. (3) Lighting Carbons.

The Moulded or Formed Insulation Section held its regular quarterly meeting at the Hotel Biltmore, New York, on October 2, E. B. Hatch, of the Johns-Pratt Company, presiding. The following standing committees were then appointed:

Committee on Standards: R. W. Seabury, chairman, Boonton Rubber Manufacturing Company; J. G. Miles, Westinghouse Electric & Manufacturing Company; S. H. Blake, General Electric Company; McConnell Shank, B. F. Goodrich Rubber Company; R. C. Buell, Johns-Pratt Company; F. E. Layman, Cutler-Hammer Manufacturing Company.

Committee on Membership: B. H. Howell, chairman, Hemming Manufacturing Company; Victor Steinberger, General Insulate Company; R. W. Seabury, Boonton Rubber Manufacturing Company.

Traffic Committee: H. M. Shaw, chairman, Shaw Insulator Company; Joseph Steinberger, General Insulate Company; S. C. Schenck, Belden Manufacturing Company.

Committee on Commercial Development: Louis Steinberger, chairman, Electrose Manufacturing Company; H. T. Meyer, Duranoid Manufacturing Company; S. H. Blake, General Electric Company.

The Wire and Cable Section will hold a dinner meeting on October 18, 1916, at the Yale Club, New York City, at 7 p. m. This will be the regular quarterly meeting of the Section, and many matters of importance will be considered in connection with plans for the year's work.

Invitations have been issued by the general secretary of the Associated Manufacturers of Electrical Supplies to all manufacturers of magnet wire to attend a conference at the Hotel Biltmore, New York City, October 19 at 10 a. m. The purpose of this meeting is to determine whether the manufacturers of magnet wire prefer to organize as an independent section to be known as the Magnet Wire Section, or as a Magnet Wire Committee of the present Wire and Cable Section of the Association. Invitations are being extended to all manufacturers of magnet wire, whether members of the Association or not, to be present at this meeting.

Census Figures on Electrical Manufactures Show Great Increase from 1909 to 1914.

The United States Bureau of the Census, Washington, D. C., has issued a preliminary summary abstracted from the census of manufactures taken for the calendar year 1914. This gives the data on manufactures of electrical machinery, apparatus, and supplies and compares the figures with the census taken for the year 1909. The figures show a very striking increase during the five-year period. In the table given below it should be noted that the figures relate only to establishments engaged distinctively in electrical manufacture .

	Census		Per cent of Increase,
	1914	1909	1909-1914
Number of establishments	1,030	1,009	2.1
Persons engaged in manufacture	144,712	105,600	37.0
Proprietors and firm members	368	439	16.2*
Salaried employees	26,266	17,905	46.7
Wage earners (average number)	118,078	87,256	35 3
Primary horsepower utilized	227,731	158,768	43.4
Captial	$355,725,000	$267,844,000	32.8
Services	109,007,000	69,574,000	56 8
Salaries	35,291,000	20,193,000	74 8
Wages	73,808,000	49,381,000	49.5
Materials	154,728,000	108,566,000	42.5
Value of products	335,170,000	221,309,000	51.4
Value added by manufacture (value of products less cost of materials)	180,442,000	112,743,000	60.0

*Decrease.

In addition to the above, in 1914, 91 establishments, primarily engaged in other lines of manufacture, produced electrical machinery, apparatus, and supplies to the value of $24,261,961, while in 1909, 142 establishments of this character manufactured $18,728,916 worth of electrical machinery, apparatus, and supplies as a subsidiary product.

Plans for Ohio Valley Electrical Exposition Announced.

A prospectus has been issued for the Ohio Valley Electrical Exposition, to be held November 18-25 at Music Hall, Cincinnati, O. The success of the show held last year has prompted the management to contract for double the amount of exhibition space used in 1915. The special attractions will be on a larger scale and will include illumination features and an ice-skating rink maintained by electrical refrigeration. The management of the exposition is in the hands of W. W. Freeman, president; L. T. Milnor, vice-president and treasurer, and H. K. Shockley, general manager.

Committees Developing Local Plans for America's Electrical Week.

As mentioned in preceding issues, the work of making local plans for carrying out the various activities of America's Electrical Week (December 2 to 9) is proceeding in all sections of the country. The chairmen of local committees are calling meetings and assigning the work to various subcommittees. At these meetings the general plans are discussed and the most important features are decided on.

At Dallas, Tex., J. H. Moseley, of the Texas Power & Light Company, announces that an illuminated parade will be a feature of the week. Several good-roads organizations and the Merchants' Association will co-operate in new street lighting and participate in outdoor demonstrations of electrical devices. The local committes in El Paso, Galveston, Houston and San Antonio are planning to make special features of local pageants, special lighting of the shopping districts, and school essays on electricity.

Meetings have been held in Salt Lake City, Ogden and Provo, Utah, under the general chairmanship of S. R. Inch of the Utah Power & Light Company. These meetings were all well attended; H. W. Alexander, of the Society for Electrical Development, made addresses at each meeting. In view of the fact that over 97 per cent of all possible customers within 300 feet of the lines of the Utah Power & Light Company are now using the company's service, special plans are required which will provide chiefly for increasing the load.

At Kansas City, Kans., meetings of the Jovian League drew a large attendance from the city and surroundings. A subcommittees has been appointed to investigate the practicability of giving an electrical show.

At Honolulu, Hawaii, the Hawaiian Electric Company, Limited, is planning to have a very active celebration of the week in the different towns throughout the island which it serves. The work is in charge of James F. Fenwick, who intends to have parades and special illuminations in Honolulu as features of an official city event.

At St. Louis, Mo., the work of the local committee is already well advanced. The general chairman is F. D. Beardslee, who has appointed ten subcommittees on the following subjects: Window decorations, newspaper contest, signs on street cars, dinner and jubilee, special discounts on electrical goods, float and band, flood lighting, advertising inserts, electric show, dealers and contractors. Each of these committees has actively taken up the work, and it is expected that exceptionally complete activities will result. All branches of the electrical industry in St. Louis are determined to make the event a complete success.

At Toledo, O., a meeting was held a short time ago at which between 400 and 500 attended. It was in the nature of an electrical rally, at which speeches were made by E. R. Kelsey, chairman of the local committeee; George W. Hill and Frank R. Coates. It is proposed to have the second annual electrical show from December 4 to 16. All booths for this show have already been sold and extra space will be needed to accommodate the increased demands of old exhibitors and the requirements of new exhibitors.

At Louisville, Ky., plans are rapidly developing for the electrical show to be held in the Armory Building. A stage will be erected in the middle of the Armory, to provide space for entertainment and dancing. Exhibits will be placed against the walls.

At the recent meeting of the Washington Association of Electrical Contractors and Dealers, a proposal to participate in America's Electrical Week was endorsed unanimously, and all members were urged to hold local celebrations throughout the state of Washington at that time.

Electrical Nights Boost America's Electrical Week Campaign.

Widespread interest in America's Electrical Week is being created through Electrical Nights in various cities throughout the country. Speakers on the staff of the Society for Electrical Development are developing interest in the week by tours of the country, addressing electrical clubs, Jovian leagues, Rotary clubs, chambers of commerce, civic associations, etc.

Harry W. Alexander, director of publicity for the compaign, is visiting Salt Lake City, Denver, Dallas, Houston, New Orleans, St. Louis, Kansas City, Chicago and Indianapolis. At each of these meetings music and buffet luncheons supply entertainment, while the speaker gives an illustrated talk on the big week and how each individual can participate with profit.

The Rotary Club of Dallas entertained Mr. Alexander, inviting as its guests the Electric Club, Jovians, advertising club, and electrical men generally. About 450 were present at the luncheon there Thursday, October 5. Following the meeting the committee announced its preliminary plans for participation in America's Electrical Week. Extensive illumination schemes for the city streets, buildings, etc., are under way. Three of the wider streets will be roped off while three bands entertain with dance music one night of America's Electrical Week.

Houston has an electric show in the making. It will also have a parade of floats on trucks. All of the Houston dealers have pledged support.

New Orleans had the biggest gathering of electrical men in its history, when on Saturday night, October 7, the local committee entertained electrical men from throughout Louisiana at its Electrical Night. Two orchestras furnished music and later a lunch was served. Mr. Alexander told what was planned for America's Electrical Week in cities everywhere.

A. H. Halloran, the Society's Pacific Coast representative, is visiting the Coast cities on a similar mission. San Francisco, Los Angeles, Spokane, Portland, Seattle, Aberdeen and other far western cities are planning big sales campaigns and celebrations. George W. Hill, of the Society's co-operative staff, has completed a tour of the South, and is now in the Middle West, speaking in Ohio and Indiana cities. New England and the Middle Atlantic States will be visited during the latter part of October by J. M. Wakeman, general manager of the Society.

The most important literature outlining the "how to" plans are in the mails. These booklets detail just what can be done to celebrate the big week December 2 to 9 with material profit.

Millions of pieces of advertising matter will begin to be distributed October 15. These include muslin banners, window lithographs, window cards, car cards, pennants, bill posters, poster stamps, etc. Description of the material with order blanks are being mailed from the Society's offices this week. All of the material is free to members and to committees and are offered at cost to non-members.

An Analysis of Electric Cooking—I

A Comprehensive Discussion of the Development of the Art—Tabulation of Central-Station Electric Cooking Rates —Actual Energy Consumption—Other Miscellaneous Data

By H. O. Swoboda
Consulting Electrical Engineer

THAT electrical energy can be employed to produce heat is known for more than one hundred and fifty years, although the first public exhibit of electric cooking did not take place until 1883, when it was demonstrated at the Vienna exposition. At that time water was boiled, once by means of a spiral of platinum wire, which was made red hot by an electric current and placed into the water, and, another time, by winding the platinum wire around the vessel, which contained the water.

Electrically heated cooking utensils, such as hot plates, tea kettles and chafing dishes, were then shown shortly after 1890 at the various electrical exhibits. In 1904 the first hotel in Europe was equipped exclusively with electrical cooking apparatus, and since that time the development of the art has been going on so rapidly that today cooking with electricity offers to become a serious competitor to the general method of preparing food with heat produced from coal, gas or other fuels.

Technical Difficulties.

There was one serious technical obstacle, preventing the general adoption of electric cooking, i. e., the lack of a suitable substance for the electric heater, as none of the known materials except the high-priced platinum withstood the heat to which they had been subjected. While the maximum heat for preparing food rarely exceeds 500 degrees Fahrenheit, the electric heater itself has to be designed for considerably higher temperatures, in order to reap the benefit of quick action and radiant heat. The first substance suitable for high temperatures was discovered about 1892 in the nickel-steel alloys, which resist heats as high as 1,000 degrees Fahrenheit without injury. This material satisfied a great many demands, and considerable quantities of it are still being used today. The real solution of the problem, however, was not obtained until about 12 years ago, when the nickel-chromium alloys appeared in the market. They can be operated at temperatures as high as 1,750 degrees Fahrenheit; in some instances even as high as 2,000 degrees Fahrenheit without being affected, and fulfilling all ordinary requirements. A few other substances with similar properties have since been discovered, but so far the nickel-chromium alloys have maintained the field. In other words: *The foremost technical difficulty which prevented the general use of electrical heat for cooking was successfully removed more than a decade ago.*

Of course, there were other troubles which had to be taken care of, such as terminal defects and poor insulation, but as they were mostly caused by the inexperience in designing heating devices, the natural development eliminated these difficulties in the course of time, and are a matter of the past for all manufacturers of experience and repute.

Central-Station Rates.

Another obstacle preventing the general adoption of electric cooking was the high cost of electrical energy. Even today the cost is not, in many cases, sufficiently low to warrant a rapid introduction of the art; nevertheless, considerable progress has been made during the last few years, and is being made every day.

With the steadily increasing capacity and efficiency of modern power plants, especially steam-operated plants, the cost of electrical energy has been cut in half within the last 10 years, and all indications point towards the repetition of such a reduction within the coming decade. Naturally, the decrease in the cost of production in most cases has also reduced the rates to the consumers.

In addition thereto, central stations have just about commenced to realize the desirability of the cooking load for their systems as an "off-peak load," and in a great many cases offer now special low rates for installations with electric ranges.

The result of the conditions just named is that in those sections of the United States and Canada where either water power or modern steam plants are available enterprising central stations are in a position to offer rates which make electric cooking just as cheap and even cheaper than cooking with gas. Since this development is still going on and the lowering of the rates continues, those sections of the country in which electric cooking competes successfully are steadily increasing in number as well as in size. In fact, it is not very hard to predict that within a comparatively short time electrical energy will be offered anywhere in the United States and Canada, and, for that matter, all over the civilized world at such rates that electric cooking can be universally adopted. It may also be well to mention that the rates in our country are by far not the lowest, and, that, for instance, in quite a number of cities in England a rate equivalent to about two cents per kilowatt-hour is charged, whereas the majority of our rates range from three to six cents per kilowatt-hour.

In order to get at the facts more accurately, the rates established by a number of central stations for domestic cooking have been compiled in the accompanying Table I. Although far from complete, it, nevertheless, shows that the rates, compared with the customary charge of 10 cents per kilowatt-hour of 10 years ago, have been cut in two in most cities, and that rates of three cents per kilowatt-hour are not very seldom. No effort has been made to compile the rates for energy for large kitchens, such as for restaurants, hotels, clubs, hospitals and industrial enterprises, because establishments of this character, as a rule, are supplied either at wholesale power rates or generate their own energy. Besides this, there are not many large kitchens compared with the countless number of individual households, and it is for this reason that the latter have received first consideration in this article.

The first column of Table I, name of city and state, gives the names of the 80 cities which were selected for a study of the rates charged for domestic cooking, and as can be seen from Table II below, both large and small communities are included, in order to secure a true picture of the situation. It may be added that these cities are located in 28 different states of the Union and in Canada. In 75 cities there is a single operating company, while in 5 cities there are two competing companies.

TABLE NO. II. CENTRAL-STATION RATES.
Population of Cities Enumerated in Table 1.

2	cities	more than 1,000,000		population
5	cities	from 500,000 to	1,000,000	population
13	cities	from 250,000 to	500,000	population
14	cities	from 100,000 to	250,000	population
6	cities	from 50,000 to	100,000	population
2	cities	from 25,000 to	50,000	population
8	cities	from 10,000 to	25,000	population and
25	cities	less than 10,000		population

TABLE NO. I—DOMESTIC RATES FOR ELECTRICAL ENERGY FOR COOKING.

(Compiled from inquiries to the various Electric Companies and Brown's Directory of American Gas Companies, 1913.)

City and State	Electric Company	ESTABLISHED RATE						ACTUAL COST IN CENTS FOR			
		Date established	Charge in cents per kwh.	Min. monthly payment	Prompt paym. discount	Separate meter ?	Special or regular	Elec. Energy per kwh for 100 kwh.	200 kwh	500 kwh.	Gas per 1000 cuft
Los Angeles, Cal.	So. Cal. Edison Co.	Prior to 2-1-16.	First 40 kwh.....7 All excess.....3	$2.50	None	No	Special	4.60	3.80	3.32	75
Redding, Cal.	No. Cal. Pwr. Co.	1-1-13.	First 100 kwh.....3 Second 100 kwh.....2½ Third 100 kwh.....2 All excess.....1½	1.00	None	Yes	Special	3.00	2.75	2.10	150
San Francisco, Cal.	Gr. Western Power Co.	Prior to 2-1-16.	Any amount.....3	1.00	None	Yes	Special	3.00	3.00	3.00	75
San Francisco, Cal.	Pac. Gas & Elec. Co.	2-3-16.	First 30 kwh.....4 Next 90 kwh.....2 All excess.....1½ For con. loads..... up to 3 kw only.....	Up to 5 Kw con. Load $5 Ea. add. Kw $1	None	Yes	Special	2.60	2.10	1.74	75
Denver, Colo.	Denver Gas & Elec. Co.	5-15-06.	Any amount.....4	$3.00	10%	Yes	Special	3.60	3.60	3.60	85
Hartford, Conn.	The Hartford Elec. Lt. Co.	7-1-14.	Any amount.....3	1.00	None	Yes	Special	3.00	3.00	3.00	90
New Britain, Conn.	The United Elec. Lt. & Water Co.	Prior to 2-1-16.	First 1.2 kwh.....10 Next 2.8 kwh.....5 All excess.....3 For ea. 100 sq. ft..... Min. 800 sq. ft.....	0.50	None	Yes	Regular Residence	4.12	3.56	3.22	115
Waterbury, Conn.	The United Elec. Lt. & Water Co.	Prior to 2-1-16.	Same as New Britain, Conn.								110
Washington, D. C.	Potomac Elec. Pwr. Co.	Prior to 2-1-16.	First 10 kwh.....10	$0.50	Net plus 10 % pen.	Yes	Special	3.70	3.35	3.14	80
Jacksonville, Fla.	City Elec. Lt. Plant.	10-1-15.	Any amount.....2	1.00	Net	Yes	Special	2.00	2.00	2.00	120
Atlanta, Ga.	Georgia R'y. & Pwr. Co.	Prior to 2-1-16.	Any amount.....4	$2.22	10%	Yes	Special	3.60	3.60	3.60	70
Twin Falls, Idaho.	Gr. Shoshone & Twin Falls Wt. & Pwr. Co.	3-1-14.	First 50 kwh.....3 All excess.....2½	1.00	10%	Yes	Special	2.48	2.37	2.20	Not listed
Chicago, Ill.	Commonwealth Edison Co.	1-29-14.	First 30 hrs.....11 Next 30 hrs.....6 Next 60 hrs.....4 Of max. dem..... (85% con. load)	0.50 per con. H. P.	1c Per kwh.	Yes	Regular power	10.00	8.19	5.29	80
Boone, Iowa.	Iowa Ry. & Lt. Co.	Prior to 6-1-15.	Any amount.....5 Min. con load 3kw.	2.50	None	Yes	Special	5.00	5.00	5.00	125
New Orleans, La.	New Orleans Ry. & Lt. Co.	Prior to 2-1-16.	First 30 hrs.....6 of max. dem. (75% con. load) All excess.....3½	8.4 kwh per con H. P.	net plus 1 cent pen. p. kwh.	Yes	Regular retail power	6.00	4.92	4.07	110
Baltimore, Md.	Consol. Gas, Elec. Lt. & Pwr. Co.	8-1-14.	First 20 hrs of max.d, 8½ All excess ..... 5 Allowances: Up to 5 H. P 5 to 25 H. P.....0.1 Above 25 H. P.....0.2 p. kwh.	$1.00	Net	No	Reg. Pwr.	6.75	5.87	5.35	80
Boston, Mass.	The Edison Elec. Ill. Co.	10-1-15.	First 20 kwh.....10 All excess..... 2	$0.75	None	Yes	Special	3.60	2.80	2.32	80
Worcester, Mass.	Worcester Elec. Lt. Co.	Prior to 2-1-16.	First 20 kwh.....11 All excess..... 4	$0.75	1 cent p. kwh.	Yes	Special	4.40	3.70	3.28	75
Detroit, Mich.	The Detroit Edison Co.	Prior to 2-1-16.	First 25 hrs of max. d. .14 (100% con. load, All excess 4	$0.50	10%	No	Regular residence	10.35	6.97	4.95	75
Duluth, Minn.	Duluth Edison Co.	Prior to 2-1-16.	Any amount.....2.4	$1.00	None	Yes	Special	2.40	2.40	2.40	85
Minneapolis, Minn.	The Minneapolis Gen. Elec. Co.	3-1-13.	First 3 kwh.....8½ Next 3 kwh.....6 All excess per room..2½	$1.00	5%	No	Regular residence	4.55	3.46	2.81	85
St. Paul, Minn.	Saint Paul Gas Lt. Co.	Prior to 2-1-16.	Fir st 52 hrs.....7.3 of max. dem. All excess 3	$1.00 per con. H. P.	10%	Yes	Regular power	6.57	6.42	3.64	100
Kansas City, Mo.	Kansas City Elec. Lt. Co.	3-1-14.	First 3 kwh per room..11 All excess Min. 3 rooms	$0.50	10%	No	Regular Residence	5.80	5.15	4.76	27
Kansas City, Mo.	Municipal Elec. Lt. Co.	Prior to 2-1-16.	Any amount.....3	Based on con. load	None	Yes	Special	3.00	3.00	3.00	27
Poplar Bluff, Mo.	Missouri Public Util. Co.	Prior to 2-1-16.	Any amount.....3	$1.00	5%	Yes	Special	2.85	2.85	2.85	Not listed
St. Louis, Mo.	Laclede Gas Lt. Co.	Prior to 2-1-16.	First 2½ kwh.....9 Next 1½.....6 per room approx... All excess.....3	$0.50	5%	No	Regular residence	4.34	3.59	3.15	80
Billings, Mont.	The Montana Power Co.	Prior to 2-1-16.	Any amount.....3	$1.00	None	Yes	Special	3.00	3.00	3.00	170
Glendive, Mont.	Hughes Elec. Co.	Prior to 2-1-16.	Any amount.....4	1.00	None	Yes	Special	4.00	4.00	4.00	Not listed
Omaha, Neb.	Omaha Elec. Lt. & Pwr. Co.	8-10-15.	First 50 kwh.....7½ Next 50 kwh.....6½ Next 100 kwh.....6 Next 100 kwh.....5½ Next 100 kwh.....5 Next 300 kwh.....4½	$0.50 per con. H. P.	½c per kwh.	No	Regular retail power	6.50	6.00	5.10	115
Jersey City, N. J.	Public Service Elec. Co.	Prior to 2-1-16	First 20 hrs.....10 Next 50 hrs.....6 Next 500 hrs.....4 of max. dem..... (100% con. load)	$0.50 per con. H. P. but not less than $1.00	None	Yes	Regular retail power	10.00	8.00	6.20	100
Newark, N. J.	Public Service Electric Co.	Prior to 2-1-16	Same as Jersey City.								100

TABLE NO. I.—(Continued).

City and State	Electric Company	ESTABLISHED RATE						ACTUAL COST IN CENTS FOR			
								Elec. Energy per kwh for			
		Date established	Charge in cents per kwh.	Min. monthly payment	Prompt paym. discount	Separate meter ?	Special or regular	100 kwh.	200 kwh	500 kwh.	Gas per 1000 cuft
Buffalo, N. Y.	Buffalo Gen. Elec. Co.	Prior to 2-1-16	First 60 hrs. 8 Next 120 hrs. 4 All excess. 1½ of max. dem. (25% con. load)	$1.00	1c p. kwh	No	Regular residence	6.00	4.50	2.26	30
New York, N. Y.	The New York EdisonCo.	Prior to 2-1-16	First 450 kwh. 8 Next 100 kwh. 7 Next 1350 kwh. 6	None	None	Yes	Regular power	8.00	8.00	7.9	80
Rochester, N. Y.	Rochester Ry. & Lt. Co.	6-1-15.	Any amount. 8	$1.00	10% up to $5.00 2% abv.	No	Regular light and power single rate	8.00	See o	ther s	chedu e
Rochester, N. Y.	Rochester Ry. & Lt. Co.	6-1-15.	Any amount. 1	$2.50 plus $3.30 per kw dem. (50% con. load)	None	No	Regular light and power three rate	See other sched.	6.38	3.15	95
Akron, Ohio	The No. Ohio T. & Lt. Co.	Prior to 2-1-16	Any amount. 2½	$1.00	None	No	Special	2.50	2.50	2.50	30
Bellaire, Ohio											30
Byesville, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								30
Cambridge, Ohio	The Ohio Service Co.	4-27-15.	First 25 kwh. 9 Next 50 kwh. 8 Next 75 kwh. 7 Next 100 kwh. 6 All excess. 5	$0.50	10%	No	Regular residence	7.20	6.53	5.40	30
Canal Dover, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								
Canton, Ohio	The Canton Elec. Co.	6-15-15.	First 80 hrs. 8 All excess. 3½ of max. dem.	$1.00	½c p. kwh	No	Special residence	7.50	7.50	3.20	30
Dennison, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								30
Cincinnati, Ohio	The Union Gas & Elec. Co.	8-15-14.	30 hrs. tot. 10.00 40 hrs. tot. 9.25 50 hrs. tot. 8.80 60 hrs. tot. 8.50 90 hrs. tot. 7.00 120 hrs. tot. 6.25 150 hrs. tot. 5.80 180 hrs. tot. 5.50 210 hrs. tot. 5.29 240 hrs. tot. 5.12 270 hrs. tot. 5.00 300 hrs. tot. 4.90 of max. dem (70% con. load)	Up to 5 kw dem. $1 ea. add kw 50c	5%	No	Regular residence	9.50	8.07	5.51	30
Cleveland, Ohio	The Cleveland Elec. Illg. Co.	Prior to 2-1-16	First 36 hrs. 10 All excess. 5	None	None	No	Regular residence	9.50	7.25	4.90	30
East Liverpool, Ohio.	The East Liverpool T. & Lt. Co.	3-10-15.	First kwhs. 11.1 Up to 4 rooms 10 kwh 5 rooms 12 kwh 6 rooms 14 kwh 7 rooms 18 kwh 8 rooms 20 kwh 9 rooms 24 kwh 10 rooms 30 kwh 11 rooms 36 kwh 12 rooms 42 kwh 13 rooms 48 kwh 14 rooms 54 kwh 15 rooms 60 kwh ea. add. act. room room 4 kwhs All excess. 5.55	$0.55½	10%	No	Regular residence	6.00	5.45	5.19	20
Midvale, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								30
New Comerstown, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								25
New Philadelphia, Ohio	The Ohio Service Co.	4-27-16.	Same as Cambridge, Ohio								30
Norwalk, Ohio	The Cleveland & South-Western, ColumbusRy. Co.	10-21-15.	First 10 kwh. 7 Next 30 kwh. 5 Next 60 kwh. 4 All excess. 3½	None	½c p.kwh	No	Regular residential and commercial	4.10	3.55	3.22	30
Sandusky, Ohio	Sandusky Gas & Elec. Co.	Prior to 2-1-16	First 15 kwh. 7 Next 30 kwh. 6 Next 60 kwh. 5 All excess. 4	$0.50	None	No	Regular residence	5.60	4.82	4.33	35
Steubenville, Ohio	The Steubenville & East Liverpool R'y. & Lt. Co.	10-12-15.	First kwhs. 9 Up to 5 rooms 10 kwh 6 rooms 12 kwh 7 rooms 15 kwh 8 rooms 17 kwh 9 rooms 20 kwh 10 rooms 22 kwh 11 rooms 25 kwh 12 rooms 28 kwh 13 rooms 32 kwh 14 rooms 36 kwh 15 rooms 40 kwh Ea. add. act. room 4 kwh. All excess. 5	$0.75	10%	No	Regular residence	5.12	4.81	4.53	30
Strasburg, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								30
Toronto, Ohio	The Steubenville & East Liverpool Railway & Light Co.	10-21-15.	Same as Steubenville, O.								30
Uhrichsville, Ohio	The Ohio Service Co.	4-27-15.	Same as Cambridge, Ohio								30
Warren, Ohio	The Trumbull Pub. Ser. Co.	4-1-10.	First 40 hrs. 10 of max. dem. (50 watts for each living room) All excess. 5	$0.50		No	Regular residence	5.80	5.40	5.16	30

TABLE NO. I.—(Continued).

City and State	Electric Company	ESTABLISHED RATE: Date established	Charge in cents per kwh.	Min. monthly payment	Prompt paym. discount	Separate meter ?	Special or regular	ACTUAL COST IN CENTS FOR: Elec. Energy per kwh for 100 kwh.	200 kwh	500 kwh.	Gas per 1000 cu. ft.
West Lafayette, Ohio.	The Ohio Service Co....	4-27-15.....	Same as Cambridge, Ohio	.....	.....	.....	.....	.....	.....	.....	30
Wellsville, Ohio.....	The East Liverpool Traction & Light Co.....	3-10-15.....	Same as East Liverpool, Ohio.....	.....	.....	.....	.....	.....	.....	.....	25
Zanesville, Ohio.....	The Ohio Elec. Ry. Co.	1915.....	Any amount.....8	$0.50	5%	No	Regular residence	7.60	7.60	7.60	35
Portland, Ore.....	The Portland Ry. Lt. & Pwr. Co.....	10-30-15.....	Any amount.....3 Min. con. load 2 kw	$1.00	None	Yes	Special	3.00	3.00	3.00	100
Beaver, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Beaver Falls, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Briegewater, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
East Rochester, Pa...	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
East Vale, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Freedom, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Monaca, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
New Brighton, Pa....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Patterson, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Pittsburgh, Pa.....	West Penn. Trac. Co.....	Prior to 2-1-16..	First kwh.....12 up to..... 5 rooms 10 kwh 6 rooms 12 kwh 7 rooms 15 kwh 8 rooms 17 kwh 9 rooms 20 kwh 10 rooms 25 kwh 11 rooms 30 kwh 12 rooms 35 kwh 13 rooms 40 kwh 14 rooms 45 kwh 15 rooms 55 kwh Ea. add. act. room 4 kwh All excess.....6	$1.20 gross	16⅔%	No	Regular residence	5.85	5.43	5.17	27½
Pittsburgh, Pa.....	Duquesne Lt. Co.....	7-1-14.....	Any amount.....6 plus serv. charge in acc. with number of rooms	$0.65	1c p. kwh	No	Regular residence	5.80	5.40	5.16	27½
Rochester, Pa.....	Beaver County Light Co.	6-15-14.....	First kwh.....12 Up to 5 rooms 10 kwh 6 rooms 12 kwh 7 rooms 15 kwh 8 rooms 17 kwh 9 rooms 20 kwh 10 rooms 25 kwh 11 rooms 30 kwh 12 rooms 35 kwh 13 rooms 40 kwh 14 rooms 45 kwh 15 rooms 55 kwh Ea. add. act. room 4 kwh All excess.....6	$1.20	16⅔%	No	Regular residence	5.85	5.43	5.17	30
Van Port, Pa.....	Beaver County Light Co.	6-15-14.....	Same as Rochester, Pa...	.....	.....	.....	.....	.....	.....	.....	30
Providence, R. I.....	Narragansett Elec. Lt. Co.	7-29-14.....	Any amount.....2 Plus serv. chge. First 4 kw .....$2.00 Ea. add. 4 kw .... 1.00 of con. load	Same as serv. chg.	None	Yes	Special	4.50	3.25	2.50	85
Memphis, Tenn.....	Memphis Consol. Gas & Elec. Co.....	Prior to 2-1-16..	Any amount.....10 Allowance 100 to 200 kwh..... 5% 200 to 300 kwh.....10% 300 to 400 kwh.....15% 400 to 500 kwh.....20% 500 to 600 kwh.....25% 600 to 700 kwh.....30% Etc.	$2.50	None	Yes	Regular power	9.50	9.00	7.70	100
Nashville, Tenn.....	Nashville Ry. & Lt. Co...	Prior to 2-1-16..	Any amount.....6	$1.00	None	Yes	Special	6.00	6.00	6.00	100
Salt Lake City, Utah.	Utah Power & Lt. Co....	Prior to 2-1-16..	Any amount if con. load less than 2 kw .....4 2 kw or more.....3	$1.00	10%	Yes	Special	2.70	2.70	2.70	120
Seattle, Wash.....	Lighting Dept. City of Seattle.....	Prior to 2-1-16..	First 45 kwh.....5½ All excess.....2	$1.50	None	No	Regular residence	3.58	2.79	2.32	100
Seattle, Wash.....	Puget Sound T. Lt. & Pwr. Co.....	4-1-15.....	First 45 kwh.....5½ All excess.....2	$0.50	None	No	Regular residence	3.58	2.79	2.32	100
Spokane, Wash.....	The Washington Wt. Pwr. Co., City of Spokane...	Prior to 2-1-16..	First 20 kwh.....8 Next 10 kwh.....6 All excess.....3	$0.70	None	No	Regular residence	4.30	.65	3.26	150
	Spokane rural districts...	Prior to 2-1-16..	Any amount.....5	$2.00	None	Yes	Special	5.00	5.00	5.00	.....
Chester, W. Va.....	The East Liverpool Trac. & Light Co.....	4-1-15.....	Same as East Liverpool, Ohio.....	.....	.....	.....	.....	.....	.....	.....	30
Milwaukee, Wis.....	The Milwaukee Elec. Ry. & Lt. Co.....	Prior to 2-1-16..	First kwh.....11 Up to 4 rooms, 4 kwh ea. Ea. add. act. room, 2½ kwh. Sec. kwh up to 7 kwh for ea. room.....5 All excess.....2	$0.50	5% up to $25 1% above	No	Regular residence	4.88	3.44	2.52	75
Montreal, Que.....	The Montreal Lt. Ht. & Pwr. Co.....	Prior to 2-1-16..	Any amount.....3	All cooking electrically	None	Yes	Special	3.00	3.00	3.00	95
Port Arthur, Ont....	The Public Utilities Commission.....	Prior to 2-1-16..	First kwh.....2½ For 4 kwh p. 100 sq. ft. up to 1,000 sq. ft., 3 kwh p. 100 sq. ft. above 1,000. All excess.....1½	$0.25	10%	No	Regular	1.64	1.50	1.41	Not listed
Toronto, Ont.....	The Toronto Elec. Lt. Co. Ltd.....	Prior to 2-1-16..	First 4 kwh p. room...4 Sec. 4 kwh p. room....2 All excess.....1	None	10%	No	Regular residence	2.06	1.48	1.13	70
Winnipeg, Man.....	City of Winnipeg.....	Prior to 2-1-16..	Any amount.....1 Plus serv. chge. of 75c p. kwh of con. load.	Same as serv. charge	10%	Yes	Special	4.65	2.77	1.65	120
Winnipeg, Man.....	Winnipeg Elec. Ry. Co...	Prior to 2-1-16..	Any amount.....3 Allowances Up to $5.00.....10% $5,00 or more.....25%	75c p. kwh of con. load	10%	Yes	Special	3.75	2.03	2.03	[120

Note.—In calculating the cost of 100, 200 and 500 kwh., the following has been assumed:
In case of "room" schedule: 8 rooms or 800 sq. ft.
In case of "max." schedule: Connected load, 5 kwh.; max. dem. 50% unless otherwise stated.

The second column of Table I, name of electric company, shows that 71 electric companies are recorded and that a number of same operate in more than one city. The operation of such companies is recorded separately for each community, resulting in a total of 85 reports, representing practically 85 self-contained distribution systems.

In the third column of Table I, date established, wherever possible (48) the dates on which the rates were established are entered and it is interesting to note that most of these rates are not older than three years. Probably

TABLE NO. III. CENTRAL-STATION RATES.
Dates on Which Rates Were Establish.

1906 established	1
1910 established	1
1913 established	2
1914 established	10
1915 established	33
1916 established	1
Total	48

the age of the remaining 37 rates, for which the dates of establishment were not secured, averages about the same.

The fourth column of Table I, charge per kilowatt-hour, indicates the rates charged and the method applied in charging. All rates are based on the kilowatt-hours consumed per month, and as registered by the watt-hour meters installed at the consumers' premises. The method of calculating the charge price, however, varies considerably, as can be seen from the following.

Methods of Charging.

Twenty-six systems, or 30.6 per cent, apply a so-called room schedule, in accordance with which the price per kilowatt-hour is reduced after a certain initial quantity at a high price has been consumed. This quantity varies in accordance with the number of active rooms in the residence. In some instances the number of the square feet of the floor space is substituted for the number of rooms.

Twenty-four systems, or 28.3 per cent, use a two, or multi-rate, schedule. As in the preceding rates, the price per kilowatt-hour is reduced after a certain initial quantity at a high price, approximately light rate, has been consumed. In this case, however, this initial quantity is the same for all consumers. Some systems make only one reduction in price per kilowatt-hour; others make two or more, setting for each step a fixed amount of current consumption.

Eighteen systems, or 21.2 per cent, have a plain kilowatt-hour schedule, there being one uniform price per kilowatt-hour, regardless of the quantity of current consumed and the capacity (connected load) of the installation.

Twelve systems, or 14.1 per cent, charge on the basis of maximum demand, as is customary for practically all power service.

Three systems, or 3.5 per cent, apply a plain kilowatt-hour schedule, same as the other 18 systems just mentioned, but in addition thereto make a fixed service charge per month.

Two systems, or 2.3 per cent, also apply a plain kilowatt-hour schedule, same as the other 18, and three systems, but give a discount, which increases with the current consumption.

These figures clearly show that the room and two or multi-rate schedules are the most favored methods of charging. The reason for this preference is that due to the scaling rate, a high return is received for a small initial amount of the energy delivered. This amount is usually made about equal to the monthly demand for light during the hours of the peak load. The energy consumed during the off-peak hours then represents the remaining amount delivered, and, of course, can be sold at a lower rate. Therefore, it is possible to use one meter for both light and cooking combined, without discriminating in the charges in favor of either kind. If a plain kilowatt-hour schedule is applied, naturally one rate for light and another for cooking should be made, necessitating two separate meters and an expensive installation.

The fifth column of Table I, monthly minimum payment, reports the minimum amounts charged each month by the various companies, whether electrical energy has been used or not. As far as the 85 systems under investigation are concerned the conditions are as given in Table IV.

TABLE NO. IV. CENTRAL-STATION RATES.
Minimum Payments.

Sixty-eight systems, or 80 per cent, insist upon a fixed, not variable minimum payment, ranging from $0.50 to $3.00 per month.

Eleven systems, or 13 per cent, insist upon a minimum payment varying either with the amount of the connected load or with the maximum demand.

Two systems, or 2.3 per cent, receive a minimum payment in the form of a fixed service charge, which is made each month whether energy has been consumed or not.

One system, or 1.2 per cent, practically insists upon a minimum payment by stipulating that all cooking must be done electrically only.

Three systems, or 3.5 per cent, do not insist upon a minimum payment.

The fixed, not variable minimum, payment, as can be seen, is the most preferred and probably the best for residential purposes, as it is the simplest method and sufficiently accurate to cover the fixed expenses connected with each installation.

The sixth column of Table I, prompt-payment discount, shows in the case of the 85 systems that 52 systems, or 61.2 per cent, allow a fixed prompt-payment discount; 30 systems, or 35.3 per cent, do not allow any prompt-payment discount, and three systems, or 3.5 per cent, provide a penalty in case the bill is not paid within a specified time.

The well-known prompt-payment discount is the leading method, and undoubtedly the simplest and best manner to eliminate a slow payment of the bills.

The seventh column of Table I, separate meter, furnishes information which practically depends upon the method adopted for charging the energy delivered, as pointed out in the explanation made for the fourth column. Of the 85 systems under consideration, 51 systems, or 60 per cent, use one common meter for all requirements, and 34 systems, or 40 per cent, install separate meters.

The eighth column of Table I, special or regular, indicates whether the rate for domestic cooking is established especially for cooking and heating, or whether for this purpose the regular residence or power rate is used.

Fifty-seven systems, or 67 per cent, use the regular residence rates, and 28 systems, or 33 per cent, use a special rate.

As all systems with the room and the two or multi-rate schedule use the same rate for light and cooking, as pointed out before, and as there are also a few systems which do the same, although they operate on the plain kilowatt-hour schedule, it can readily be understood that fully two-thirds of all systems can successfully supply energy for

TABLE NO. V. CENTRAL-STATION RATES.
Charges for the Purchase of 100, 200 and 500 Kilowatt-Hours per Month.

Charge in cents per kwh.	For 100 kwh. No. of systems act.	per cent	For 200 kwh. No. of systems act.	per cent	For 500 kwh. No. of systems act.	per cent
1.00-1.49	....	.....	1	1.2	2	2.4
1.50-1.99	1	1.2	1	1.2	2	2.4
2.00-2.49	4	4.7	5	5.9	9	10.5
2.50-2.99	4	4.7	8	9.4	6	7.1
3.00-3.99	14	16.5	19	22.4	19	22.4
4.00-4.99	12	14.1	7	8.2	9	10.6
5.00-5.99	21	24.7	20	23.5	32	37.6
6.00-6.99	8	9.4	15	17.6	3	3.5
7.00-7.99	12	14.1	3	3.5	3	3.5
8.00-8.99	2	2.4	5	5.9	....	.....
9.00-9.99	3	3.5	1	1.2	....	.....
10.00 or more	4	4.7	....	.....	....	.....
Total	85	100.0	85	100.0	85	100.0

domestic cooking without making a special rate. Of course, these systems were obliged to readjust their old residence light schedule to the new conditions before this was possible.

The ninth, tenth and eleventh columns of Table I, actual charge in cents per kilowatt-hour, became necessary, be-

cause the various methods of charging for electrical energy make a direct comparison impossible, unless a fixed number of kilowatt-hours for each system are actually calculated in accordance with the various schedules. This has been accomplished in these three columns for a purchase of 100, 200 and 500 kilowatt-hours within one month, with the result shown in Table V.

By rearranging the figures of Table V slightly, the conditions found in Table VI will be obtained.

TABLE NO. VI. CENTRAL-STATION RATES.
Charges for the Purchase of 100, 200 and 500 Kilowatt-Hours per Month.

Charge in cents per kwh.	For 100 kwh. No. of systems act.	per cent	For 200 kwh. No. of systems act.	per cent	For 500 kwh. No. of systems act.	per cent
Less than 1½	....	.....	1	1.2	2	2.4
Less than 2	1	1.2	2	2.4	4	4.8
Less than 2½	5	5.9	7	8.3	13	15.3
Less than 3	9	10.6	15	17.7	19	22.4
Less than 4	25	27.1	34	40.1	38	44.8
Less than 5	35	41.2	41	48.3	47	55.4
Less than 6	56	65.9	61	71.8	79	93.0
Less than 7	64	75.3	76	89.4	82	96.5
Less than 8	76	89.4	79	92.9	85	100.0
Less than 9	78	91.8	84	98.8	....	.....
Less than 10	81	95.3	85	100.0	....	.....
Less than 11	85	100.0	....	.....	....	.....

The figures of the last two tables show that the lowest charge for 100 kilowatt-hours is between 1.5 and 2 cents; the lowest charge for 200 and 500 kilowatt-hours is between 1 and 1.5 cents; the charge made by more than 50 per cent of all systems lies between 3 and 6 cents per kilowatt-hour, and the highest charge for 100 kilowatt-hours is slightly in excess of 10 cents. The highest charge for 200 kilowatt-hours lies between 9 and 10 cents, and the highest charge for 500 kilowatt-hours lies between 7 and 8 cents.

Of all the systems investigated 10.6 per cent charge less than three cents for a monthly purchase of 100 kilowatt-hours, 65.9 per cent less than six cents, and only 4.7 per cent adhere to the customary charge of 10 cents of 10 years ago.

The twelfth, or last column of Table I, gas per 1,000 cubic feet, was added for the purpose of enabling a comparison of cost to be made between electrical energy and gas in the cities in which the 85 systems which were investigated operate. While the cost of the gas by no means is the only factor which an electric company has to study in deciding upon its rate for domestic cooking, it is well not to underestimate the influence of this largest competitor.

Effect of Load on System.

One of the other factors affecting the electric-cooking rate, is the influence of this load on the feeder system, through which the energy is delivered to the consumer. While the maximum demand for a single range seems to be between 35 and 40 per cent of its connected load, the maximum demand for groups of ranges, as shown in the first three items of Table VII, does not exceed 15 per cent (14.6 per cent) of the connected load. In other words, the diversity-factor is about 1 to 7, permitting the installation of seven times as many ranges on a feeder system, as the connected load apparently would permit. In fact, it is even considered safe (L. A. Gale) to figure on a ratio of 1 to 10, as the maximum demand of the domestic-cooking load does not occur at the time of the station peak.

TABLE NO. VII.
Central-Station Rates—Connected Load, Maximum Demand and Diversity-Factor for Domestic Ranges.

Name of City or Country.	No. of Households.	Connected Load, Kw.	Maximum Demand, Kw.	Diversity-Factor Per Cent.
Salt Lake City, Utah	24	77	11.5	15.0
Great Falls, Mont	21	110	13.5	12.3
Worcester, Mass	16	77	13.5	17.5
Anaconda, Mont	22	92	.....	.....
Canada	1	.....	2.9**	.....
England	1	6.2	2.2*	36.6

*1.75 kw. are light and heat.
**Maximum demand during six successive days.

Similar conditions exist for large kitchens. The two named first in Table VIII, and supplying regular restaurant service, furnish meals at all hours of the day to single persons or small parties at short notice, and, therefore, must have a high maximum demand as well as a high diversity-factor (57.8 per cent, or 1 to 1.75). The other four kitchens, however, supply meals only at fixed hours of the day to large groups of persons at one time, and consequently have a maximum demand and diversity-factor (37.7 per cent, or a 1 to 2.6) fully one-third smaller than the other two. In addition therefore it should be borne in mind that battleships, as well as the two enterprises named, have their own power houses, which when the help ceases to work for the purpose of eating, operate with a minimum load, and, therefore, can supply the entire cooking energy without an increase in the capacity of the plants.

TABLE NO. VIII.
Central-Station Rates—Connected Load, Maximum Demand and Diversity-Factor for Large Kitchens.

Place of Installation	Connected Load, Kw.	Average Demand, Kw.	Maximum Demand, Kw.	Diversity-Factor Per Cent.
Engineer's Club, Boston	30.0	.....	18.0	60.0
Quaker Cafeteria, Sacramento, Cal.	96.2	.....	55.0	57.3
U. S. Battleship *Texas*—				
Officers' Galley	120	27.4	54.0	45.0
Crews' Galley	240	21.2	90.0	37.5
Siemens - Schuckert Co., Berlin, Germany	93	20-40	40.0	43.0
North German Lloyd, Breman, Germany	194	40-60	60.0	30.9

New York Rapid Transit Report.

That a crosstown subway in Brooklyn reaching into Queens is indispensable to the proper development of those two boroughs is pointed out by Commissioner Travis H. Whitney and LeRoy T. Harkness, chief of rapid transit, of the Public Service Commission for the First District, New York, in a report to that body dealing with the third-tracking of the Fulton Street Elevated line in Brooklyn and with the whole transit situation in the Borough of Brooklyn. The report also recommends the institution of negotiations with the New York Municipal Railway Corporation looking towards the fixation of a price at which the existing elevated railroads in Brooklyn can be taken over by the city. Such a step will be preliminary to the removal of certain of the elevated structures from the streets of Brooklyn.

A line in Livingston Street, Brooklyn, is suggested in the report, to be built with funds raised by assessment upon property benefited, together with certain funds provided by the city.

It is suggested that a committee of ten be named, five appointed by the New York Municipal Railway Corporation of Brooklyn and five by the Public Service Commission, to institute negotiations with the railway corporation looking to the making of a valuation of the elevated railroads in Brooklyn. The report states that if this committee is appointed at once such rapid progress may be made that within a period of a few months it can be shown whether success or failure will attend the plan.

The City of New York recently received its first financial returns from operation under the dual system contracts when the Interborough Rapid Transit Company paid into the office of Comptroller Prendergast the sum of $8,584.73 as rental under the certificate for third tracking on the lines of the Manhattan Elevated System. This certificate granted by the Public Service Commission for the First District at the time of the signing of the dual system contracts in 1913 provided that the company pay to the city two per cent of the increased receipts of stations served by express trains. The rental received covers the initial operation of the third tracks from January 17, 1916, to July 1, 1916.

Abstracts of Illuminating Engineering Society Lectures

Exterior Illumination

By LOUIS BELL

THE adaptation of the eye to different intensities of light is involved in the problem of exterior illumination, as one can see well in moonlight if there are no bright surfaces in the field of vision. Hence, uniformity of light intensity might seem to be important, but at low illumination we see largely by the help of shadows. It is best to have only moderate uniformity, with proper direction of light flux.

Exterior lighting may be divided into four classes, typified by the public square, the street, building exteriors, and parks. Public squares should be highly illuminated, and the lamps should have high mounting to reduce the number of poles, and should be in large units, such as 1,000 candlepower in diffusing globes. In street lighting, the street surface is a first consideration, but building fronts must be illuminated also. A common fault is to ignore the character of the street and treat all alike. Where traffic is dense the lighting should be similar to that of a public square. Otherwise such intensities would be wasteful. The minimum is fixed by the possibility of adequate policing.

Streets may be divided into three classes: (1) boulevards and business streets; (2) residence streets where there is considerable traffic; (3) less frequented streets. Well lighted streets may have variations in intensity in the ratio of 1 to 25, and it is hard to secure better than 1 to 10. The average intensity in streets of the second class should be 0.05 to 0.1 foot-candle, and for the third class about one-half of these values. Large units should be mounted not less than 30 feet high, and small units from 15 to 20 feet; but this depends upon spacing. The best place for lamps depends upon the nature of the street. On narrow streets they may be placed along the curb. On wide streets mast-arms may be used, or posts may be placed in the center of the street.

Glare should be avoided. It is less when lamps are mounted high. The method of lighting monuments and buildings will depend upon their character and their surroundings. It may sometimes be done from ornamental posts, but flood lighting is preferable if a suitable place can be found for the lamps. As flood lighting uses all of the light from the unit, it is easy to calculate the required flux. In street lighting, also, it has been found that the useful illumination is nearly proportional to the total light flux from the lamp. In parks and open spaces no help is obtained by reflection from lateral surfaces. Usually, low intensities are sufficient.

It is as yet an unsettled question as to whether incandescent or arc lamps should be preferred for outdoor work. Small arc lamps are going out of use, but the large sizes in modern types are holding their own. The great obstacle to the use of colored light is the expense, since screens must be used, except for the colors obtainable from certain flame arc lamps. From 50 to 80 per cent of the light is lost if deep hues are used, and this represents great inefficiency. It is often better to mix colored and white light.

The Lighting of Factories, Mills and Workshops

By C. E. CLEWELL

ACTUAL data show that in some cases good lighting has increased factory output 12 per cent, decreased spoilage 25 per cent and decreased accidents 25 per cent. Other advantages of proper lighting are the reduction of eye strain, reduction of fatigue, increase of order and neatness, making surroundings more cheerful, and making superintendence and management more efficient. Tests have shown that only 25 per cent of garment workers examined have normal vision and this is probably due to improper illumination at their work. A diagram was given showing the cost of lighting in terms of wages, and such data constitute the strongest and best argument for adequate lighting, since the best lighting often costs daily only as much as the wages of shop employees for one minute of the day. In many cases the cost of lighting is shown to be about 1 per cent of the wages. A summary of lighting legislation and intensity specifications were given as adopted in Great Britain, Pennsylvania, Wisconsin and the code of the Illuminating Engineering Society. The general requirements of factory lighting are sufficient intensity and the avoidance of glare. These are usually best secured by the use of fixed units, equipped with reflectors under a general or localized general system. It is well to have an auxiliary system, which is automatically thrown into service if the primary source of energy fails.

In designing an installation, the area to be lighted multiplied by the average intensity, will give the number of lumens which it is necessary to supply. This number is divided by the utilization-factor to give the total lumens necessary to be supplied by the lamps. Dividing this by the number of units gives the size for each unit. A safe value for utilization-factor is 0.3, although the actual value if often higher than this. The point-by-point method is not satisfactory for laying out an installation, but is useful in checking the uniformity of the illumination. (The article by the same author in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 2 and 9, 1916, covers the subject fully.)

Abstracts of Illuminating Engineering Society Lectures

Architectural and Decorative Aspects of Lighting

By GUY LOWELL

THE architect and the engineer have different points of view, which may be designated as subjective and objective. The artistic effect sought by a lighted object is to bring up a train of thought in the observer. It is an emotional effect. The scientific mind has difficulty in appreciating the artist's problem. The architect frequently tries to get effects regardless of efficiency, but where his lighting scheme is mainly for use he will make it as economical and efficient as possible. Flood lighting is effective when used as at the Panama Pacific Exposition, but it is difficult to apply it appropriately to single buildings. Thus the new building of the Massachusetts Institute of Technology was planned by the architect to be lighted from above and horizontal illumination does not give the proper effect.

In interiors such as living rooms, table lamps give the most artistic lighting, wall brackets being useful only as decorations when unlighted, but may be lighted when no tables are used in the room. A private library should be lighted mainly by table lamps, with a little general lighting to give a decorative effect. In too many cases the lighting is scientifically correct, but artistically vile.

In designing the lighting of a Boston art museum a model room of variable height was used. It was found that paintings need diffused light, while sculpture and bric-a-brac require lighting from the side. To be artistic, lighting should resemble daylight as nearly as possible. North lighting is not necessary for paintings. Art galleries should have large and not narrow rooms, and large light-colored wall surfaces lighted to a low intensity are very valuable in providing diffused light. Skylight lofts should be whitewashed. The common ratio of window area to floor surface of 20 per cent is suitable for high rooms, but in many cases 12 or 15 per cent would be sufficient.

The Lighting of the Home

By H. W. JORDAN

THE home needs better illumination than has been customary. In poorer homes utility and cost receive first consideration, but in the more expensive ones artistic effects are to be considered. Where rooms are decorated according to the style of different periods, efficiency must sometimes be entirely sacrificed to appearance. Convenient switching should always be provided and care taken in locating outlets so as to prevent waste. Care should also be exercised in the selection of glassware and fixtures, as frequently there is no difference in cost between good and bad samples. It is somewhat difficult to keep up with new advances in available units, and the architect should consult the engineer.

In the living room the most important consideration is the provision of proper reading lamps. These should not be opaque, but should throw some general light throughout the room. They are to be preferred to a chandelier on account of glare. Too often the shades are selected for decoration without regard to utility. Small portable lamps have decorative value. The lamp should be wired on at least two circuits so that two intensities of illumination will be available. Ceiling units are suitable only with high ceilings and must conform to other decorations. With low ceilings wall brackets may be used and often have high ornamental value.

In the dining room the art-glass dome is suitable in many cases, but must be propertly located and is best without fringe. It should contain extra sockets for attaching devices. Wall switch and pull chains should be provided. In more pretentious houses luminous bowls may be used containing several sockets and controlled by a wall switch. Extra outlets should be provided on the floor or baseboard. In palatial residences chandeliers may be used with multiple wall brackets to get proper effects.

In the library the surroundings are usually dark. Ceiling fixtures with proper reading lamps are desirable. Wall brackets are not suitable. In a music room, brilliant lighting is not necessary, but local lighting should be provided for a piano, and most suitably by a floor lamp. A soft general illumination is desirable and cove lighting would be suitable here. Wall brackets are objectionable.

In the kitchen a shallow prismatic reflector is suitable. If it is a large room more than one may be required. If there is a hooded range there should be a lamp under the hood and one is often needed over the sink. Receptacles should be provided for irons and other devices. Where a hall is used as a living room, a semi-direct unit is usually pleasing. Second-floor halls need less light than first-floor, and where there is only one lamp it should be at the top of the stairs, with wall-switch control from both floors.

Bedrooms should be lighted to suit the color scheme of the room. Wall brackets are desirable on each side of the mirror. A lamp should be provided for reading in bed, with pendent switch. In the bathroom, wall brackets should be provided on each side of the mirror. Porches need only low illumination, but both front and back porches should be lighted so as to illuminate the steps and the faces of visitors. An inclosing globe with switch inside the building is suitable. Closets should be lighted by automatic switches.

An Indoor and Outdoor Stage-Lighting Outfit

A Comparatively Simple and Inexpensive Equipment Used for an Outdoor Production Under Tent Covering, but also Suitable for Indoor Amateur Theatricals, Etc.

FOR several years there has been a growing tendency in this country to give outdoor entertainments. The first of the more pretentious productions of this kind in the East was the production of "Siegfried" at the Harvard Stadium over a year ago, but this was an outdoor production only in the sense that there was no roof over the audience. A complete stage was set up and the lighting problems were almost, if not quite, identical with those of an indoor performance. This was followed by several other open-air productions of opera, and at Lexington there was given an impressive outdoor pageant which relied almost entirely upon natural scenery, and was the first real attempt to establish a technique for outdoor lighting.

There has not yet grown up any established practice in outdoor stage lighting, because the productions are infrequent and the cost of suitable equipment has run very high. The only type of outdoor lighting which is at all common is street lighting, and standards for street lighting have changed so rapidly that they have frequently become obsolete almost over night. It is easy to see that there are many difficulties in the way of economically meeting the varied requirements of outdoor pantomime or play.

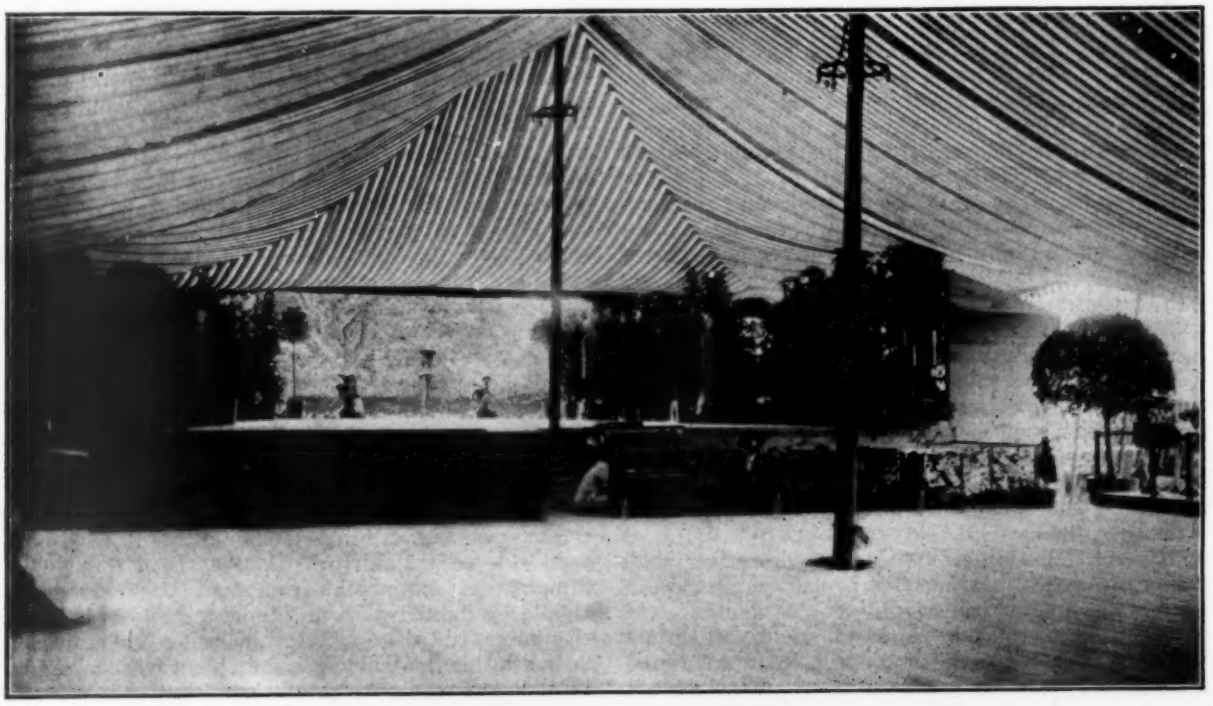
The first difficulty encountered in outdoor lighting is the absence of reflected rays. In a theater no scenery is so absorbent of color that there is no reflected light, but when one is dealing with green trees and shrubbery the reflected light is so small that it is quite negligible, and all results must be secured from direct illumination.

Recently a chapter of the Red Cross was organized at Southampton, Long Island, and a series of entertainments was planned in order to raise funds. The first of these was the production of an outdoor amateur musical revue, to be given in a tent, and Glenn Marston, of New York, was called upon to design lighting equipment for the affair, with the understanding that it should be adaptable to indoor entertainments which will be given in the winter, ranging from those on a completely equipped stage down to the most informal impromptu in a drawing room.

For the outdoor production a tent was secured, 120 feet long and 60 feet wide. In one end was erected a stage, 45 by 30 feet over all. The tent was so located that its center line, if extended, would pass directly between two large elm trees about 200 feet behind the stage. Under these elm trees there was a hedge, behind which could be seen flowering shrubbery. By leaving the back of the stage open, the elm trees and their surroundings formed an unusua! substitute for a back drop. The sides of the stage were decorated with bay trees and shrubbery in which nestled marble statues from the Italian garden of the estate of James L. Breese. The front of the stage was covered with chicken fence wire into which were woven oak leaves, giving the impression that the whole stage was a terrace, with a lower terrace in the background.

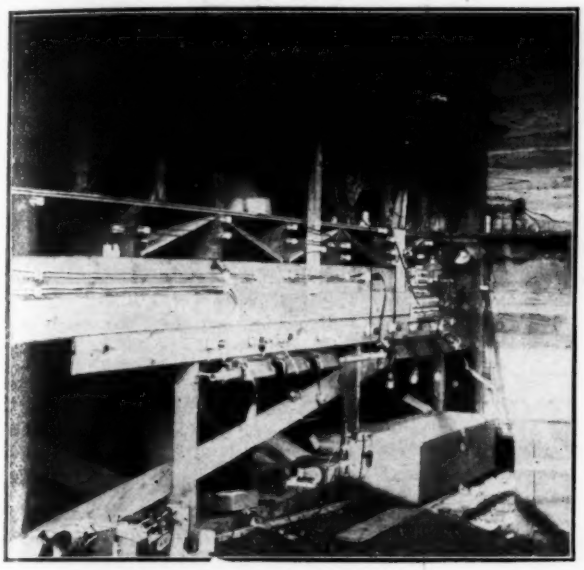
A novel feature was the use of a steam curtain for scenes which required the placing of chairs and other accessories. This curtain was used for periods varying from one to three minutes, and caused no inconvenience to the audience whatever. The source of steam was the village road roller, which was borrowed for the occasion. On the steam curtain projectors played varicolored lights in reds. greens and ambers, with striking effect.

In order to meet all the requirements of the outdoor production coupled with the future uses of the equipment, it was necessary to make special designs for some of the equipment. The most important units in the apparatus prepared by Mr. Marston were a number of metal boxes for use on the floor of the stage. In the last season or two it has become quite the fashion to do away with footlights in dramatic productions, but light from below is so frequently desirable that provision for it still needs



Daylight View of Stage Before Performance.

to be made. In [redacted] production under discussion the stage was painted gree[redacted] There was a great deal of dancing on it, and if dependence had been left to lighting from overhead, or from any elevation at all, the effect would have been to give a dirty cast to all of the draperies which



Improvised Switchboard at Side of Stage.

received reflected light from the floor itself. This, of course, was highly undesirable.

The boxes designed by Mr. Marston are 13 by 13 by 26 inches, with one side open and slightly pitched. These boxes are each fitted with two X-ray projectors containing 250-watt type C Mazda lamps. They are grooved for color screens. Four of them were used for the production, three on the stage, and one to furnish illumination for the background, as shown in the plan.

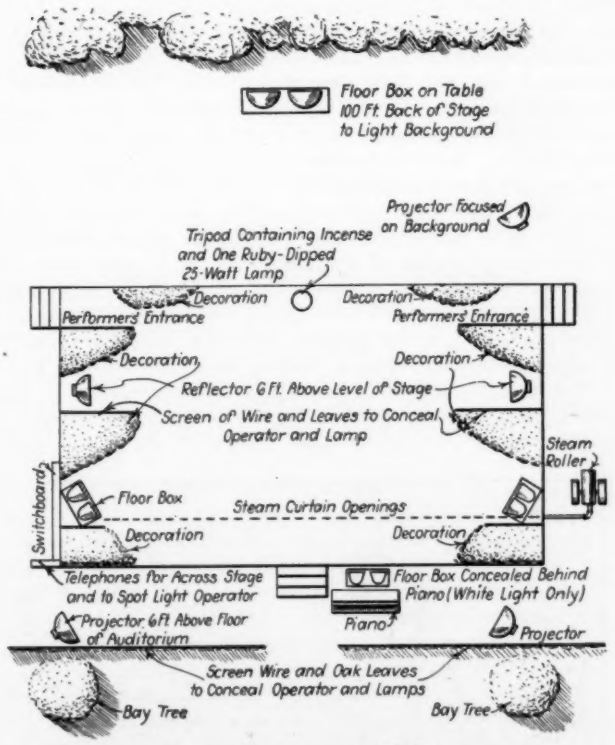
Two aluminum parabolic reflectors, fitted with 100-watt stereopticon lamps, and three single X-ray projector units, fitted with 250-watt lamps, completed the lighting equipment, except for two spotlights, which were borrowed. Seven dimmers were purchased, which made it possible to fit a dimmer to each of the lamps lighting the stage with the exception that one dimmer was used for both lights in the box at the front of the stage.

The location of the various pieces of equipment is shown in the accompanying plan of the stage. The floor boxes were placed at the front corners of the stage, two aluminum reflectors were placed on the stage, and two projectors were placed on the ground about six feet in front of the stage, one on either side. These were masked by bay trees and screens of chicken fencing covered with oak leaves. The projectors and aluminum reflectors were mounted on collapsible stands with a maximum extension of ten feet. They were actually used about six feet from the floor. All equipment was fitted with grooves for color screens.

The accompanying large view shows the general appearance of the stage shortly before the decoration was completed. It was impossible to obtain a night picture, but the trees in the background were illuminated during the entire performance by special equipment shown on the plan. The small view shows the temporary switchboard. The use of separable plugs obviated the need for switches, and the board was so constructed that any dimmer could be cut out and used for any piece of equipment. The dimmers, of the portable type, were mounted on a six-foot length of pipe. On the shelf can be seen the buzzer connecting with the operator of the steam curtain and the loud-speaking telephone transmitters. One of the telephones connected with the opposite side of the stage, and the other with the spotlight operator, who was located on a platform near the top of the center pole of the tent, just above the ring of lights shown in the photograph of the stage. The telephones were improvised, being taken from the automobiles of obliging owners, and fitted with extension cord.

In designing the equipment it was necessary to keep in mind the fact that it would frequently be operated entirely by amateurs, and therefore must be kept down to as few units as possible and be quite simple to operate. It was also necessary to consider the various kinds of entertainment usually given by amateurs and prepare to meet the needs of all of them without any cumbersome apparatus. In order to make possible operation in a drawing room, without scenery of any kind or any means of concealing the light source, each piece of apparatus is equipped with 20 feet of stage cord. By using two, or possibly three, of the floor boxes, and placing color screens before the beginning of a performance, it is possible to secure a wide variety of effects without having an operator appear in the room at all. The lamps are each on separate dimmers, so that one color can be pulled down while another is coming up This can be done from behind a half-opened door, or behind a screen of some sort. The cables are simply laid under rugs, and there is nothing obtrusive or out of taste in evidence.

Wherever these boxes have been used they have met with unqualified approval. They are open to one objection, however, and that is a tendency to throw shadows. In drawing-room entertainments this is not serious, for the background is permanent, and is not a matter of interest to the audience. Where there is scenery it is always pos-


Floor Box on Table 100 Ft. Back of Stage to Light Background
Projector Focused on Background
Tripod Containing Incense and One Ruby-Dipped 25-Watt Lamp
Decoration
Performers' Entrance
Reflector 6 Ft. Above Level of Stage
Screen of Wire and Leaves to Conceal Operator and Lamp
Steam Roller
Switchboard
Floor Box
Steam Curtain Openings
Telephones for Across Stage and to Spot Light Operator
Floor Box Concealed Behind Piano (White Light Only)
Projector 6 Ft. Above Floor of Auditorium
Piano
Projector
Screen Wire and Oak Leaves to Conceal Operator and Lamps
Bay Tree

Plan of Stage Showing Location of Lighting Units.

sible to use a projector or two to cut out any shadows which would otherwise appear. Heretofore there has been no lighting fixture designed to illuminate a public performance within a limited space, nor has any attention been paid to securing a unit which can be placed in full view of the audience. When painted a dark color—green, black and slate have been used with equal success—the floor

boxes pass unnoticed by the audience. Under most conditions they can be screened by a low box of flowers when used in a drawing room, for this does not interfere with the line of vision of the audience. Even such screening, however, is usually unnecessary.

The cost of this equipment is so low that it is within the reach of organizations undertaking entertainments—either indoor or outdoor—on the most modest scale. A few hundred dollars covers the cost installed, and once the association, town, or village purchases it, it is permanent, and can be used over and over again, with an infinite variety of results. The equipment herein described is adequate for a production where as many as forty people are to be lighted at any one time, which means that the usual pageant employing a total of several hundred people in its different episodes can be satisfactorily lighted at an expense within ordinary reach.

Lighting Features of Cleveland Industrial Exposition.

The Industrial Exposition and Fair given under the auspices of the West Side Chamber of Industry of Cleveland, O., closed on Sunday, September 10.

The success of the affair attracted widespread attention. Secretaries of five state fairs visited the exposition to secure data for similar fairs to be conducted in their own states. The directors of the Chamber of Industry were so well pleased with the success of the exposition that they are considering its repetition next year and making it a permanent annual event. Nine tents were required to house all the exhibits.

There were between 190 and 200 exhibitors.

One item which contributed largely to the success of the exposition was the good lighting provided. A particularly noticeable point was the absence of deep shadows. As stated in a previous issue the tract of land on which the exposition was located covered about 14 acres, being about 1,500 feet long and varying in width from 200 to 400 feet. For the general illumination of this ground 50 flaming arc lamps were installed, hung in pairs on poles running the length of the grounds. At the wider sections two rows of poles were used. As the average illuminating intensity was from six to eight foot-candles it was deemed unnecessary to use reflectors on these lamps and they were accordingly omitted. These lamps were operated at 10 amperes in one series circuit. For this purpose a temporary transformer vault was erected at the eastern end of the grounds containing a Kuhlmann constant-voltage transformer and an Adams-Bagnall 24-kilowatt arc-light transformer. Current at 2,300 volts, single-phase, was brought into the Kuhlmann transformer, stepped up to 3,800, and then connected to the primary of the arc-light transformer which maintained a constant current of 10 amperes on the lamps. Current for all purposes was furnished by the municipal plant through a temporary pole line about 2.7 miles long extending from the grounds to a substation of the municipal plant. Three-phase current at 2,300 volts was transmitted over three No. 2 B. & S. solid weatherproof wires.

In addition to the 50 arc lamps there were 25 100-watt nitrogen lamps without reflectors hung on poles to illuminate the grounds. These 25 lamps, in addition to 32 750-watt lamps placed in the nine large tents, also constituted the all-night circuit, all the rest of the lights being turned off at 11:30 p. m.

All secondary distribution was by three-wire Edison system, all lamps being operated at 110 volts except the series arc circuit, 220 volts being supplied for some 220-volt single motors used in some of the exhibits and concessions.

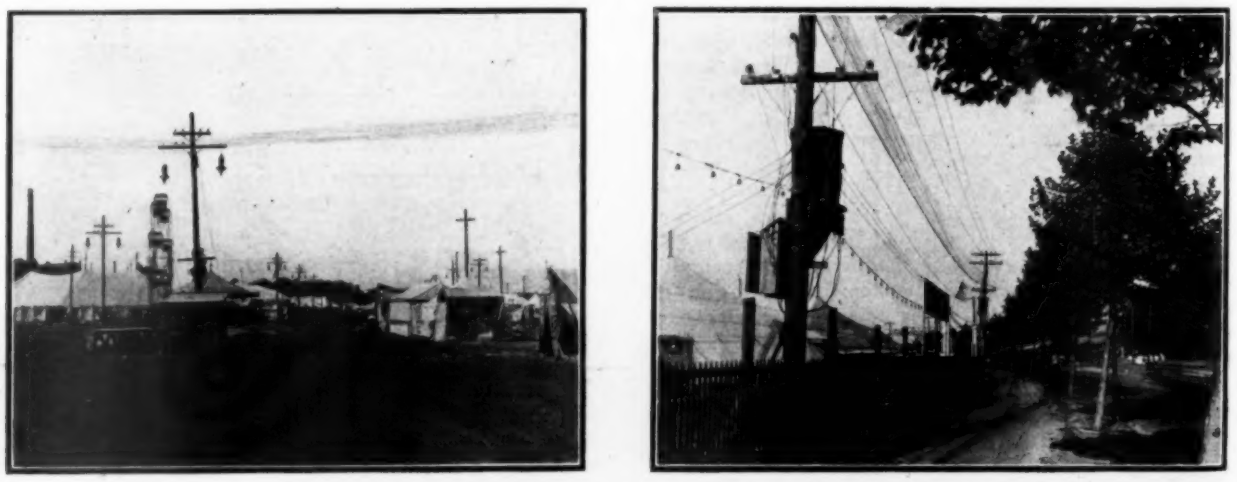
Six 50-kilowatt single-phase transformers mounted on poles carried the lighting load. In eight of the large tents there were 460 100-watt nitrogen lamps in 10-inch Sudan glass reflectors, and 34 500-watt units with Abolite reflectors.

One large tent was occupied entirely by the Anna Dean Farm exhibit. This was lighted by five 500-watt nitrogen units without reflectors and 30 100-watt nitrogen lamps with Abolite reflectors. An outdoor stage was illuminated by five 1,000-watt and five 750-watt type C lamps, all with Abolite reflectors. On the south side of the boulevard, outside of the exposition grounds, space was set aside for auto parking purposes. This was illuminated by six 1,000-watt and six 500-watt lamps with Abolite reflectors.

To light the way to the nearest car line, 300 feet of streamers with 40-watt lamps spaced every 18 inches were used.

A streamer 1,500 feet long with a 40-watt lamp every 18 inches was strung the length of the grounds along the boulevard side. On one of the nearby factories was placed a searchlight with a 30-inch projector. This was installed and maintained in operation by the National Carbon Company, as were also the arc lamps in the exposition grounds.

Seven tons of copper wire were required in the electrical construction work about the exposition. The whole equipment was installed in about six days under the personal supervision of A. R. Flint, superintendent of construction for the Vedder Electric Company, the electrical contractor.



Temporary Lighting Installation at Cleveland Industrial Exposition.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

Free Service Inspections and Repairs for Residence Customers Bring Excellent Results.

The plan of making a free inspection of the service of all residence customers is being worked out with great success in the several central-station companies that are subsidiary to the Illinois Traction System. The scheme has been worked out to have a service crew of six men go from one city to another, spending from one week upwards in each town. Each city is divided into six districts, one man taking each district and covering it completely. Calls are made on every residence customer, about 40 calls being made per day on the average. The service inspector examines all of the lighting and wall outlets, and with a number of tools that he carries along, makes such slight repairs as are found necessary in sockets, switches, shadeholders, plugs, cords, etc. Incidentally he also replaces any fuses that may be blown. The men comprising the crew have been carefully selected from the different cities in which the company's plants are located. At the head of the crew is J. P. Carnahan, formerly superintendent of the central station at Monticello, Ill. He acts as general supervisor of these service activities, and also makes inspections himself, particularly of special cases; each evening he receives the reports of the other men of the crew. The entire plan has been devised by the Commercial Department of the Illinois Traction System, at the head of which is W. B. Miser, of the Peoria, Ill., headquarters. So far, the cities of Galesburg and Danville, Ill., have been entirely covered by this inspection service. The crew is now working in Champaign, Ill. It is intended to continue this inspection through all of the properties of the company.

From the results already achieved it has been shown that an extremely valuable service is rendered by this crew, a service of value both to the customers and to the central station. The added load from the large number of sockets and appliances that were found out of commission and which required merely slight repairs to put them into service again, has more than made up for the cost of sending this crew around, including all of the incidental advertising, traveling and other expenses. A large number of circuits have been found entirely out of commission, due to failure on the part of customers to report this fact. In one city, in a house that was wired for 20 lamps, only a single lamp was found in serviceable condition; in this case it took one man a whole day to put things in order again. In every city, following the visit of the crew, the results of their work have been evident, through the increased bills immediately following, showing that lamps and appliances that formerly were not in use had been put back into service. The customers have in every case been greatly pleased with the interest shown by the central station in improving the service, and have been more liberal users of current than heretofore.

The plan of announcing the visit of the crew is to have a half-page advertisement in the local newspaper prior to the visit. This announces that the object is to improve the service and put circuits, sockets and appliances into working order, as far as this is possible on the premises. While the crew is working in the city, advertisements frequently appear advising the customers that if their houses have not yet been visited they can be assured that the visit will be made before the crew leaves the city. Another feature of the work is that the men give information regarding the service in general, and particularly regarding the desirability, advantages and costs of various electrical appliances. No appliances or lamps are sold by the men, but their visits have been the means of very greatly stimulating actual sales of electrical appliances of all kinds, particularly flatirons, toasters, percolators and washing machines.

A similar scheme on a smaller scale has been worked out very advantageously in one of the towns served by the Indiana Utilities Company, of Angola, Ind. In this town there was formerly a municipal plant, the electrician of which was retained when it was taken over by the company. Being thoroughly well acquainted in the town, where almost every resident knew him by his first name, he was asked to make a visit to every customer and make slight repairs, suggest ways in which the service could be improved by using lamps better adapted to different rooms and fixtures, etc. Practically one month was spent in making the rounds of the customers. The results in increased load and also in subsequent sales of appliances paid the salary of the man several times over.

This scheme has been advocated for several years by the Wisconsin Railroad Commission, which has urged the central-station companies in Wisconsin to make periodic inspections of the circuits of all customers, particularly residence customers. It has been tried out in a number of cities and towns in the state with gratifying results.

Minneapolis Bakery Uses Electric Ovens and Complete Electrical Equipment.

An interesting application of electricity has been brought to light by a contract recently secured by the sales department of the Minneapolis General Electric Company. Electricity will be used exclusively for baking under this contract, and it is the first purely electrical bakery in Minneapolis. The equipment consists of three 40-kilowatt ovens, the heating element being arranged for two heats, a high heat of 40 kilowatts and a low heat of 10 kilowatts. The capacity of each oven is 400 loaves and it requires approximately 30 minutes for each bake. The full 40 kilowatts are turned on at first, requiring one hour to come to proper heat. The current is then cut off and loaves are put in. About the last 10 minutes of the baking period the low heat is thrown on to brown the loaves.

All equipment of the bakery, including dough mixer, moulder, divider, sifter, proofer, rounder, wrapper and cleaner, is individually motor-driven, the horsepower being approximately 25. There is another interesting feature of the baking plant, and that is a six-kilowatt electrically heated boiler for supplying steam to the bread during the baking period, and also for the supply of hot water for washing purposes.

The equipment is so arranged that the maximum demand of the installation for the present will not be over 60 kilowatts and under present conditions the annual revenue will amount to about $1,500.

Milwaukee Residential Electric Rates Reduced.

For the fourth time in three years, the Milwaukee (Wis.) Electric Railway & Light Company has announced a voluntary reduction in its residential electric rate schedules.

The schedules of the Milwaukee company employ the counted, or so-called active, room as the basis for determining the amount of energy to be consumed monthly by customers at the various steps of the schedule.

The company's present rate provides a primary charge of ten cents per kilowatt-hour for the first four kilowatt-hours consumed per month in each of the first four active rooms, and for the first two and one-half kilowatt-hours consumed in each active room in excess of the first four, with a secondary rate of five cents per kilowatt-hour for all consumption in addition to that specified at the primary rate up to a total of seven kilowatt-hours per active room, after which the tertiary, or low step of the rate of two cents per kilowatt-hour, applies to all excess consumption.

The present change in the rate effects a reduction of one cent per kilowatt-hour in the primary rate, as compared with the primary rate of 11 cents which was previously obtained. The rate includes free renewals of all standard lamps of 40 watts and larger, and liberal renewal allowances on Mazda lamps smaller than 40 watts. The rate is subject to a monthly minimum charge of 50 cents and a prompt-payment discount of five per cent on all bills of $25 or less, with one per cent for amounts in excess of $25.

In determining the number of so-called active rooms the company eliminates three bedrooms, bathrooms, closets, basements, garrets and halls not furnished as living quarters.

This rate is highly advantageous to all customers, but particularly so to customers residing in small apartments and cottages, and its characteristics are such that high load-factor automatically earns a low rate. Cooking and all sorts of domestic heating and power appliances, including automobile charging rectifiers, are supplied under this rate, so that the "All Electric Home" can readily obtain an average rate of three cents per kilowatt-hour or less. The rate includes complete service, there being no additional charge for meter rent, trouble service, lamp delivery, etc.

The present rate reduction has been made pursuant to a promise made by the company about a year ago to reduce the primary step of its rate when the number of its customers reached 40,000. The company has made a further promise that it will again reduce its primary rate from 10 cents to nine cents gross, when the number of customers reaches 50,000.

Brooklyn Edison Company Holds Very Successful September Sales.

During the month of September the Edison Electric Illuminating Company of Brooklyn conducted two special sales which yielded very satisfactory results.

For the one month only, the Brooklyn Edison Shop offered a $90 electric washing machine for $78, the sum of $6 to be paid on the delivery of the machine, and the balance in 12 monthly installments of $6 each. The company made 103 sales in its Edison Shop and branch offices, selling over $8,000 worth of washing machines. Each machine was delivered by the company's own trucks, and demonstrated on the customer's premises, in order to give the customers or their maids ample opportuity to become familiar with the operations pertaining to the machine.

The company also conducted a successful campaign during September on 300-watt units for outside lighting. A proposition was made to merchants for the installation of a 300-watt type C lamp, complete with fixture and outer globe, together with outrigger, necessary wiring to meter and patrol switch, for $12, this sum to be paid by a deposit of $2 on signature of the contract, and $2 per month for five months. The lamps are operated on a flat rate of $3.44 per month, the company's patrolmen turning them on at dusk and off at midnight. During the month orders were secured for 325 lamps.

Boston Edison Company Renews Lighting Campaign.

With the coming of autumn with its longer evenings the Boston Edison Company is undertaking a renewed propaganda for the lighting of homes. The accompanying advertisement, which fills a nine-inch double-column space,

Put this Light in your home
If you are not now using electrical illumination in your home, you are depriving your family and yourself of a wonderful convenience and a great comfort. For reading or sewing at night Electric Light is ideal—its soft and steady brilliance prevents eye-strain.
Electricity Is Really Economical
Recent improvements in Mazda lamps have made the cost of Electric Light less than other forms of illumination.
And with electricity in your home you can enjoy so many time and labor-saving conveniences.
Let us tell you about our Easy Payment house wiring plan. Free estimate on your property. Just phone Oxford 3300, Sales Department, and we will send a man to your address, or write for booklets.
The Edison Electric Illuminating Co. of Boston
39 Boylston Street and 16 Suburban Stores

Advertisement Used in House-Lighting Campaign.

is being run in suburban newspapers. The particular point is the economy of the Mazda lamp, which makes the cost of electric lighting less than other forms of illumination.

Plans for Celebrating Edison Day.

October 21 will be the thirty-seventh anniversary of the invention of the incandescent electric lamp by Thomas A. Edison. To commemorate the day it is intended again to celebrate it as Edison Day. Plans for this purpose are maturing for making the celebration even more effective than that of last year. An extremely large amount of publicity matter has been sent out to central stations and local dealers throughout the country. The day has been and will be thoroughly advertised, both in national magazines and in

local newspapers. Special displays are being arranged for show windows and salesrooms. Local newspapers are being provided with articles deaing with the invention of the electric lamp, with the life of Mr. Edison, and with interesting features connected with the development of the lamp in the last thirty-seven years. This special publicity is being developed chiefly by the Edison Lamp Works of General Electric Company, of Harrison, N. J., which expects that the returns resulting from Edison Day will this year greatly exceed the extremely large sales of Edison Mazda lamps which were made last year on Edison Day and immediately following.

In honor of Edison Day, a special double number of *The Edison Sales Builder* has been issued that contains pertinent articles on this celebration.

Central-Station Energy for Flood-Lighting Industrial Plants.

An example of the opportunities presented for the sale of central-station energy for flood-lighting industrial plant buildings is presented in the accompanying illustration of

Flood Lighting of Flour Mill.

one of the mills of the Sperry Flour Company, Stockton, Cal.

The front of the building is illuminated by means of ten 500-watt projectors which are installed on the roof of one of the other mills of the company, 600 feet away. One of the sides of the building is illuminated in the same manner, and equipment is being installed to illuminate the other side. There are signs on both sides of the building similar to those on the front, and when the installation is completed the company will derive benefit from its advertising signs at night, as well as by day.

Such a flood-lighting installation brings excellent publicity returns to the industrial company, and is a very satisfactory load for a central station.

Connecticut Lighting Companies Make Great Power Gains.

Remarkable gains in the power load are the outstanding feature of the operation of leading Connecticut central stations, in comparison with the figures for the preceding business year. From the annual returns of eight of the foremost companies for the year which ended June 30, 1916, as filed with the Connecticut Public Utilities Commission on September 15, it is seen that the power business in the state is in an extremely brisk condition. Remarkably heavy industrial power loads have been acquired from mills and factories, with the result that in several cases the amount of electricity sold for power except to street railways was 30 to nearly 200 per cent greater in 1915-1916 than it was in 1914-1915.

The annual report of the Stamford Gas & Electric Company, with a highly developed industrial territory, shows a gain in this item of 187.6 per cent, while the Derby Gas Company's electricity department made an increase in power sales of 137.5 per cent. The United Illuminating Company, which has as its field the busy cities of Bridgeport and New Haven, increased its power sales by 68 per cent.

The connected power load in horsepower of motors on the lines shows no such ratio of increase, indicating that existing installations are being used to nearer capacity limits than formerly. The only conspicuous instance of greatly enhanced motor installations is in the case of the Derby Gas Company, whose load is almost twice that of a year ago and more. This condition is perhaps a better and more favorable symptom than were the rise in power consumption due principally to motors installed for emergency or temporary service; and it augurs a continued use of the installations after the war orders and other exceptional conditions, have passed.

Turning to the record of energy generated, it is to be noted that the Hartford company generated about the same volume as in the year before, but purchased over 16,000,000 units; that the United company's output was about 50 per cent more than for the previous year, while that of the Connecticut Power Company, the Stamford Gas & Electric Company and the Derby Gas Company was practically double the output of 1914-1915. The Connecticut Power Company sold more than 25,000,000 units to other companies, from its large tide-water stations and its hydro-electric generating station at Falls Village.

Though power was the large feature of the year's operation, the output of energy for lighting also increased, in some cases in a very marked degree. The United and the Torrington companies show the most conspicuous increases, a large portion of the increases being attributable to night operation of factories. The Hartford company made an excellent showing, its metered lighting output being substantially increased. It is interesting to note that as the direct result of a 30 days' campaign in the spring, 1,264 apartments and other homes were connected, and there are yet a considerable number which will be wired the present fall. The number of customers increased 4,000, as did that of the Bridgeport-New Haven company. All the other companies noted in the table show substantial gains in every department:

COMPARATIVE OPERATING FIGURES OF EIGHT LEADING CONNECTICUT ELECTRIC LIGHT AND POWER COMPANIES.

COMPANY	Kwh. Generated 1915-16	Kwh. Generated 1914-15	Current Bought 1915-16	Current Bought 1914-15	Current Sold for Power Except for Street Rys. 1915-16	Current Sold for Power Except for Street Rys. 1914-15	No. Customers 1915-16	No. Customers 1914-15	Con. Power Load h. p. 1915-16	Con. Power Load h. p. 1914-15	Per cent Increase of Power Load, 1916
Hartford Electric Light Co.	44,280,500	44,961,800	16,779,400	3,255,000	29,404,600	20,545,000	22,868	18,806	24,152	21,229	43.1
United Illuminating Co., New Haven and Bridgeport	50,699,700	34,231,900	12,660	3,800	22,044,600	13,118,000	18,953	14,623	29,737	22,219	68.0
Connecticut Power Co., New London*	37,296,700	15,508,700	98,400	.....	4,026,700	3,486,700	5,434	4,927	5,995	5,317	15.5
Stanford Gas & Electric Co.	9,745,600	5,282,000	.....	.....	6,195,000	2,154,300	3,760	3,272	3,760	3,000	187.6
Meriden Electric Light Co.	5,073,500	4,554,100	.....	.....	2,502,000	2,232,000	1,605	1,368	3,800	3,500	12.1
Rockville-Willimantic Ltg. Co.	35,370	172,500	2,792,430	2,390,300	1,311,200	901,000	2,190	1,917	1,150	1,121	45.5
Torrington Electric Light Co.	13,850	1,103,250	4,615,500	2,139,800	2,013,500	1,494,000	2,114	1,594	2,589	2,289	34.7
Derby Gas Co. (Electric Dept.)	6,944,000	3,848,600	.....	.....	4,518,250	1,901,400	1,254	980	6,662	3,672	137.5

*Sold to other companies, 25,347,250 kilowatt-hours.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Taps on Delta-Connected Transformers.

A manufacturer recently received an order for three large transformers with 70 per cent taps. When they were installed, delta-connected, it was discovered that they did not give 70 per cent voltage across the taps. The condition existing is shown by Fig. 1. The line voltages are represented by triangle $a\ b\ c$, and the tap voltages by $a'\ b'\ c'$. It is evident that the voltage $a'\ c'$ is somewhat less than $a'\ c$, which was specified 70 per cent. Incidentally, the purchaser ordered autotransformers to correct the voltage.

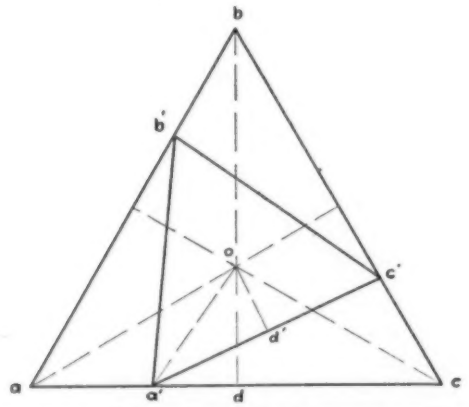


Fig. 1. Voltage Relations in Delta-Connected Transformer.

The following solution may prevent some one from making the same mistake or remind him to inform the manufacturer of the voltage required across taps with a delta connection.

Drawing the medians of $a\ b\ c$, we locate o; $o\ a'$ and $o\ d'$ are partial medians of $a'\ b'\ c'$. From the conditions of the problem we have given $a\ c$ and $a'\ c'$, the line and tap voltages respectively, and we wish to know the position of the tap in the transformer, that is, $a'\ c$ in per cent of $a\ c$.

$$d'\ o = 0.867\,a'\ c'/3 = 0.289\,a'\ c'$$

$$a'\ o = 0.578\,a'\ c'$$

$$d\ o = 0.289\,a\ c$$

$$a'\ d = \sqrt{(0.578\,a'\ c')^2 - (0.289\,a\ c)^2}$$

$$a'\ c = 0.5\,a\ c + \sqrt{0.335\,(a'\ c')^2 - 0.083\,(a\ c)^2}$$

In terms of $a\ c$ as unit we have:

$$a'\ c = 0.5 + \sqrt{0.335\,(a'\ c')^2 - 0.083}.$$

In the case mentioned above $a'\ c'$ is 0.7 and $a'\ c$ is 0.785. Fig. 2 gives the result graphically.

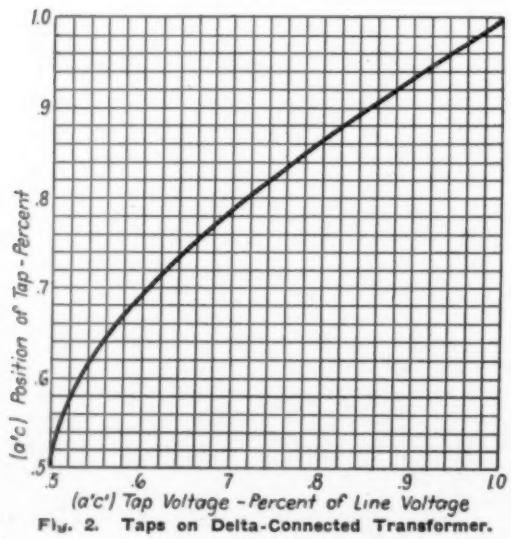
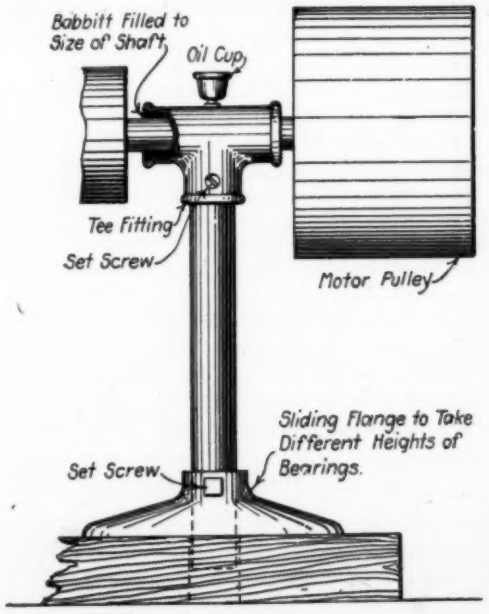


Fig. 2. Taps on Delta-Connected Transformer.

Home-Made Motor Bearing for Use in Emergency.

Frequently much valuable time is wasted when motor bearings stick or become "frozen" so badly as to break, this meaning that the shop or department in which the motor is providing power has to be shut down until another bearing or complete end frame can be secured from the factory or repair shop. To save this trouble and expense due to needless shut down, I have developed a contrivance which takes care of the bearing until it is possible to get another one to fill its place. All that is required is a tee fitting and a piece of pipe, a pipe flange and some babbitt metal. The threads in the tee fitting act as a lock to the babbitt to prevent it from slipping out. The babbitt is poured in to make the bearing of the exact size of the shaft. I have kept on hand a number of such tee fittings for various sizes of shafts. All of these are arranged to fit the same stand. An oil cup can be screwed into the top of the tee after a suitable hole has been drilled for this purpose. I use a flange with a set screw that can be adjusted up and down on the stand to be suitable for different heights of bearings. In the case of small motors it may be necessary to use two 45-degree angle fittings connected together by a short nipple so as to make the bearing clear the armature and pulley.

Walter Morris.



Emergency Motor Bearing.

Polyphase Motor Windings—XI

By Justin Lebovici

Previous installments of this article have dealt with two-layer and single-layer windings, the details of open and closed lap and wave windings being discussed and illustrated and numerical examples worked out. In the last installment it was shown how, by changing the number of poles, windings may be adapted to two speeds. In this installment rotor windings for two-speed induction motors and short-circuited rotor windings are considered and a study made of insulation. Next week the testing of insulation and the mechanical design of coils will conclude the series.

Rotor Windings for Two-Speed Induction Motors.

The rotors of two-speed induction motors are generally of the squirrel-cage type, since this type of rotor can be used in a given stator independently of the number of poles of the stator. One objectionable feature of this arrangement is the fact that if the rotor end-ring resistance is designed to give a high starting torque at the low speed, the slip at the high speed will be too large, resulting in a low efficiency. To avoid this, the end-ring resistance may be selected so as to fulfill the starting requirements at low speed, and at the same time the rotor bars will be provided with equipotential connections

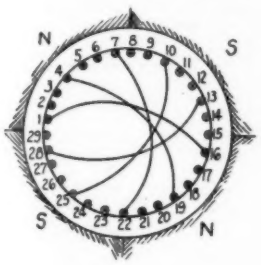


Fig. 148.

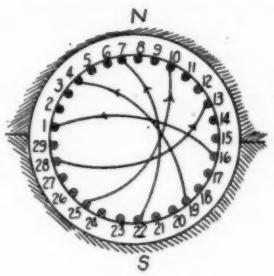


Fig. 149.

which are not effective at the low speed but become effective in lowering the rotor resistance when the speed is changed. The bars connected in this manner need not necessarily be of exactly the same potential at the low speed but should be of nearly the same potential.

Example No. 51.

A squirrel-cage rotor having 29 bars is placed in a stator arranged for four or two poles. Fig. 148 shows the condition for the low speed, or four poles, and Fig. 149 shows the conditions when the stator is changed so as to give high speed, or two poles. In Fig. 148 it will be seen that points 4 and 19, for example, are of nearly the same potential, hence very little current will flow through this connection, and most of the current will flow through the high-resistance winding from bar 4 toward bars 10 and 26 at the instant shown in Fig. 148. After the stator connections have been changed to give two poles, the difference in potential between points 4 and 19 becomes great and most of the current will flow through this connection, thus greatly reducing the resistance of the winding and reducing the slip.

Another method of increasing the resistance of the rotor winding during the starting period at the low speed consists in the use of a phase winding with three slip rings and resistances connected between slip rings the same as in an ordinary slip-ring motor. These external resistances are used only with the low-speed stator connection, the slip rings being short-circuited when the motor is changed to the high-speed connection.

Figs. 150 and 151 represent, respectively, the low-speed ($2P$ poles) and the high-speed (P poles) connections of a multipolar rotor winding. It has been explained in connection with the two-speed stator windings how the six sections marked 1_s, 1_f, etc., in Fig. 150 are obtained, starting from a continuous wave or lap winding.

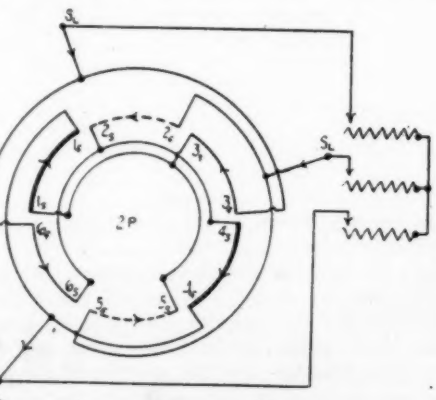


Fig. 150.

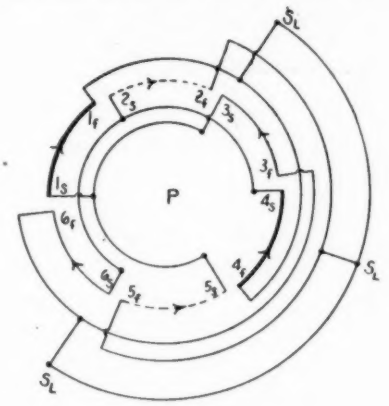


Fig. 151.

Figs. 152 and 153 show the same connections as in Figs. 150 and 151 and the change in connections may be more easily noted.

Example No. 52.

Assume a three-phase, 45-slot, 45-coil rotor winding. The stator winding is connected to give 4 and 8 poles and the rotor is to be connected to correspond with the stator. The rotor winding will be connected to three slip rings, as an external resistance box will be used in starting. We have

$Z=45 \quad S=90 \quad p_1=4 \quad p_h=2 \quad n=3$

$Z=(\text{whole number}\times p)+1=22\times 2+1=45$

$Z=(\text{whole number}\times n)=15\times 3=45$

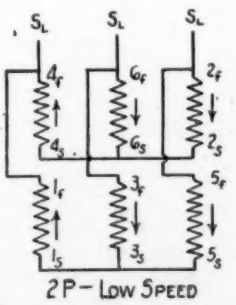


Fig. 152.

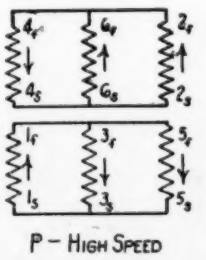


Fig. 153.

Since $S/6=90/6=15$ is an odd number, we will divide the winding into alternate sections of 16 and 14 coil sides each.

$\tau_h=90/4=22\frac{1}{2}$ $\tau_l=90/8=11+\frac{1}{4}$ $(\tau_h+\tau_l)/2=16.9$

$y_h=y_l+y_s=(90\pm2)/2=44$

$y_l=17$ $y_s=27$

We can now lay out Table XLIX and Figs. 154 and 155, in which the six resulting sections are connected as per Figs. 152 and 153 respectively. The direction of the currents for one instant is given and the change in the number of poles is easily traced. It should be noted that the current in the rotor is obtained by induction from the stator and its direction for a given instant depends on the stator connections.

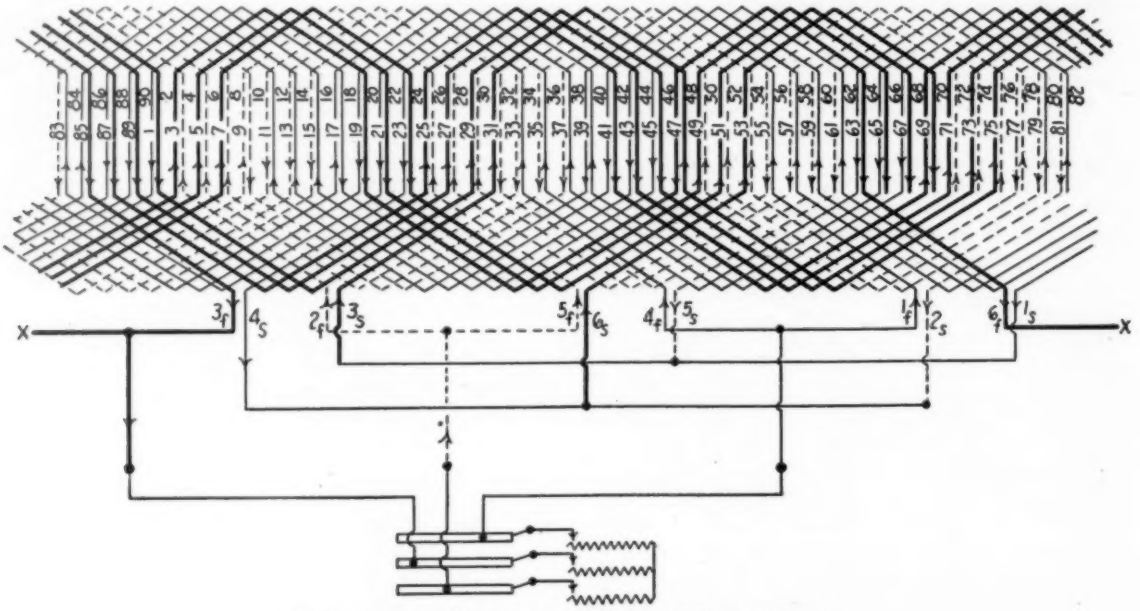


Fig. 154.—Connections for Eight Poles, Giving Low Speed.

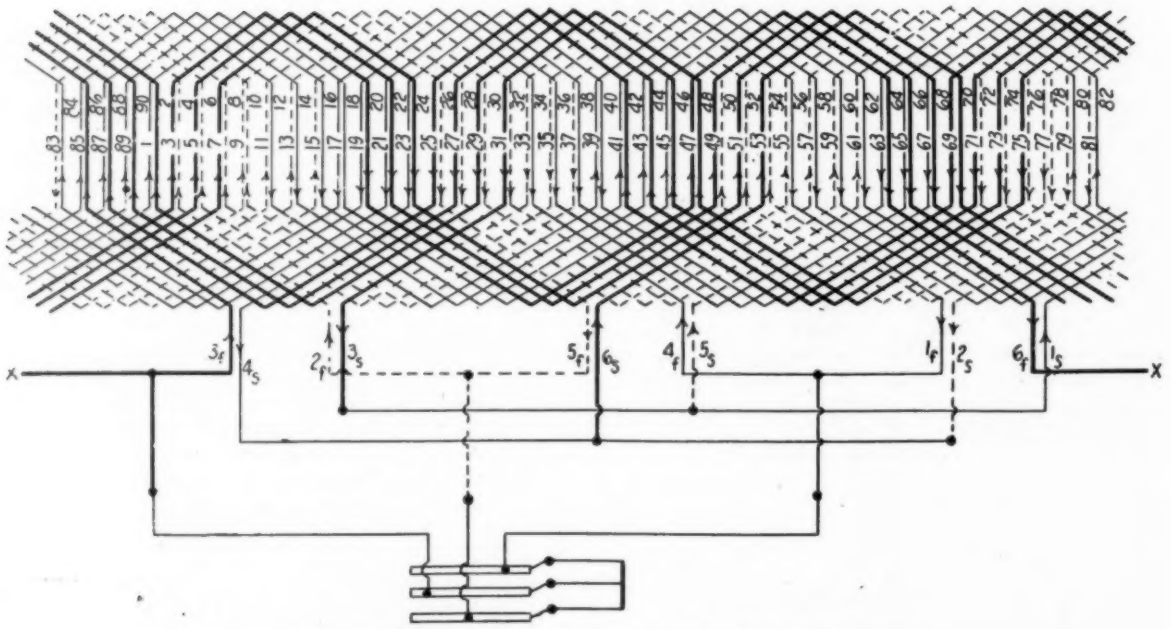


Fig. 155.—Connections for Four Poles, Giving High Speed.

In case it is necessary to reduce the speed of the motor below normal speed with high and low-speed connections, two independent rotor windings can be used, each being wound for a number of poles corresponding to the number of poles of the stator winding, or any of the schemes previously given in connection with two-speed stator windings can be resorted to. The rotor must be provided with six slip rings and the external resistances must be transferred from leads A_1, B_1, C_1 to leads A, B, C in Figs. 156 and 157 when changing from low to high speed. The connection selected for these figures is the same as given in Fig. 127.

Short-Circuited Rotor Windings.

In case the speed of an induction motor need not be varied, or the resistance of the rotor winding need not be increased at starting, we are free to increase the number of rotor phases and permanently short-circuit these phases.

(*a*) The common squirrel-cage winding, having one bar in each slot and these bars short-circuited by end rings of a proper section and material to provide a specified starting torque, is generally used in medium-sized polyphase motors and in small single-phase motors of the "split-phase" type. The electrical connection between the bars and end rings is obtained by means of solder, rivets, screws, mechanical pressure between bars and rings, or a combination of solder and one of the above means. In some motors the rings are cast around the bars, or the bars and rings are welded together. In large sizes and in cases

where the starting conditions are severe and repeated at short intervals, the squirrel cage being subjected to expansions and contractions, it is found advisable to depart from the squirrel-cage type of winding.

(*b*) Single-phase motors are often started as repulsion motors, this requiring a direct-current armature for starting. In order to obtain the short-circuited polyphase rotor winding after the motor has come up to speed, it is common practice to

TABLE XLIX.

1s 1	18	45	62
89	16	43	60
87	14	41	58
85	12	39	56 1t
2s 83	10	37	54
81	8	35	52
79	6	33	50
77	2t 4	31 3s	48
75	2	29	46
73	90	27	44
71	88	25	42
69	3t 86	23 4s	40
67	84	21	38
65	82	19	36
63	80	17	34 4t
5t 61	78	15	32
59	76	13	30
57	74	11	28
55	72	9	26 5t
6s 53	70	7	24
51	68	5	22
49	66	3	20
47	64 6t		

short-circuit all the commutator bars, thus obtaining a short-circuited polyphase winding with as many phases as there are commutator bars per pole.

(*c*) To overcome the difficulties inherent to the mechanical construction of the squirrel cage, a short-circuited barrel winding is sometimes used. Fig. 158 represents such a winding, consisting of coils connecting bars spaced approximately one pole pitch apart. The coils are made by slotting a strip of copper as shown in Fig. 159 and spreading the same, as shown in Fig. 160.

Example No. 53.

Fig. 158 shows the winding arrangement of a four-pole rotor short-circuited barrel winding, having 12 slots and 12 coils.

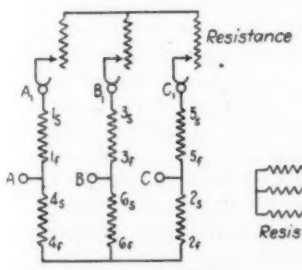


Fig. 156.—Low Speed.

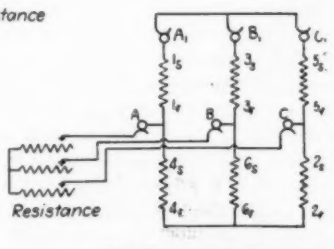


Fig. 157.—High Speed.

Insulation.

Since the greatest part of the breakdowns occurring in electrical machinery is due to failure of the insulation, it is important that the insulation should be made as safe as possible, even to the extent of sacrificing other considerations in the design of the machine. Much time could be devoted to a discussion of this subject, but since numerous books and papers on the subject are available, we shall limit ourselves here to a few examples giving the method of insulating small and medium-sized motors according to present-day practice.

In general it may be stated that enough insulation has to be provided to prevent breakdown due to the difference in potential existing between the turns of the winding itself and between the coils and surrounding iron or "to ground." The insulating material should be such that it can undergo handling without mechanical injury. In selecting the insulation the degree of heating of the machine must also be kept in mind. The final step in the insulation of the winding is to give it a varnish treatment giving a smooth finish to allow for

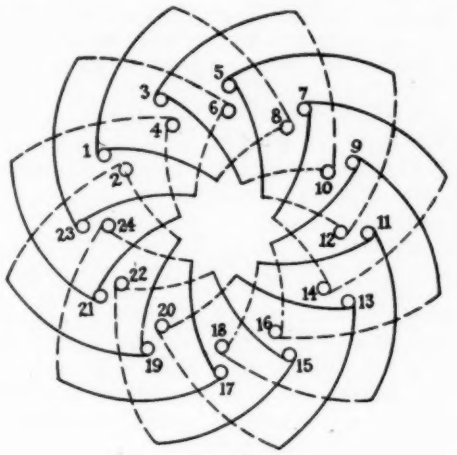


Fig. 158.

contact with oil due to oil thrown from the bearings, or other causes and to prevent short-circuiting due to the accumulation of dust and dirt while in service.

Some manufacturers prefer to put most of the insulation in the slot (in the form of a slot cell) while others prefer to place the most of the insulation directly on the coils. The latter method is preferable, since it enables the customer to obtain, from the manufacturer, spare coils ready for use in case repairs are necessary, and because each coil may be tested before it is placed in the machine.

We have the following to consider:

(*a*) The insulation of the individual conductors.
(*b*) The insulation of the coils.
(*c*) The slot insulation.
(*d*) The finishing insulation.

(*a*) For windings made of wire larger than No. 16 B&S, double-cotton-covered wire is the cheapest and most used. When wire smaller than No. 16 is used it is advisable to use a single-cotton-enamel-covered wire due to the improvement in the copper space-factor. For very small wire the cotton covering takes up too much space, hence double-silk-covered or single-silk-enamel-covered wire, although more expensive, may be used to advantage. Large rectangular copper, wrapped with linen tape, is used in coils having a few turns of large cross-section. The taping of these conductors may be done by hand or by a taping machine.

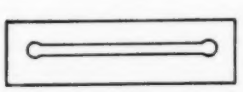


Fig. 159.

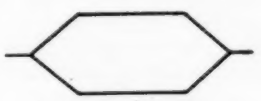


Fig. 160.

(*b*) Coils used with open slots are completely taped and finished before being placed in the machine.

Coils used with semi-inclosed slots have only the "heads" taped, this taping being done either before or after the coils are placed in the machine. The tape used is usually 0.75 to 1 inch wide with a thickness of 0.006 to 0.009 inch. The coils separating the phase groups in polyphase machines should be taped with one or two layers of oiled muslin in addition to the linen tape. In all cases the coils are wound and formed before the insulation is applied.

A few examples of coil insulation follow.

Case I. Coils to be used in a low-voltage machine having open slots, and the bulk of the insulation is placed in the slot proper. In this case it is sufficient to tape the coil all over with 0.75-inch linen tape, 0.006 to 0.008 inch thick. It is advisable to dip the coil in varnish and bake before the tape is applied. The coils separating different phase groups in polyphase machines should have the heads reinforced with one or two layers of 0.75-inch oiled muslin or empire cloth, 0.006 to 0.009 inch thick before the linen tape is applied. The wrapping of the tape should be done so that the tape is half lapped.

Case II. Coils to be used in low-voltage machines with open slots and most of the insulation is to be placed on the coil proper.

(1) Tape skinned places with silk tape.
(2) Place paper between layers.
(3) Heat coil at least one-half hour at 100 degrees centigrade to expel all moisture.
(4) Dip in varnish and bake according to varnish manufacturer's specification.
(5) Tape with oiled muslin on heads and about one inch from bend.
(6) Place cotton sleeving, of proper color, over the leads.
(7) Tape all over with 0.75-inch linen tape, one-half lap. Tape to be about 0.006 to 0.008 inch thick.

Case III. Coils to be used in 2,200-volt induction-motor stator having open slots and slot proper is carefully lined.

(1) Heat coil to expel moisture.
(2) Dip in varnish and bake.
(3) Tape with two layers, one-half lap, of one-inch oiled muslin 0.009 inch thick.
(4) Tape with one layer, one-half lap, of 0.75-inch linen tape 0.006 inch thick.
(5) Heat coil to expel moisture.
(6) Dip in varnish and bake.

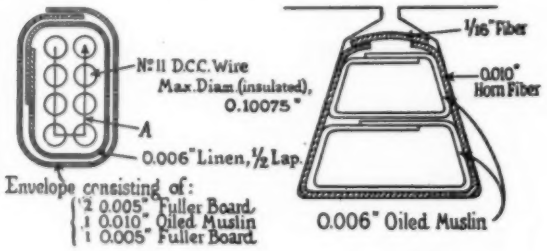


Fig. 161.

Fig. 162.

Case IV. Coils to be used in induction-motor stators, for 500 volts or less, having open slots and with all insulation placed on the coil proper.

(1) Heat coil to expel moisture.
(2) Dip in varnish and bake.
(3) Tape coils one-half lap, with 0.006-inch linen tape one inch wide.
(4) Heat coil to expel moisture.
(5) Dip in varnish and bake.
(6) Envelop slot portion and straightaways with one piece of 0.005-inch fuller board, one piece of 0.010-inch oiled muslin, and two pieces of 0.005-inch fuller board. Fasten the ends with shellac.
(7) Phase coils (coils separating two phases) to have heads reinforced with two layers of 0.010-inch oiled muslin, half lapped.

In calculating the space to be allowed for the insulation the following allowances are made. Allowance for increase in diameter of insulated wire when dipped in varnish is 0.003 inch, for No. 10 B&S or larger, and 0.002 inch for smaller than No. 10. Allowance for increase in width or depth of coil when dipped in varnish is 0.010 inch. These allowances should be taken as only approximate since they refer to one particular grade of varnish, and should be modified for other grades of varnish.

Example No. 54.

Assume a 220-volt induction-motor stator coil to be insulated as per Case IV. The coil has eight turns of No. 11 B&S double-cotton-covered wire. Fig. 161 shows a section through the slot portion of the coil. The arrow *A* shows the rotation in which the wire is wound to avoid cross overs.

	Width of Coil in Inches	Depth of Coil in Inches
Space for wire	0.2015	0.4030
Increase due to varnish on wires	0.0040	0.0080
Linen tape, one-half lap	0.0240	0.0240
Increase due to varnish on coil	0.0100	0.0100
Envelope	0.0500	0.0750
Total	0.2895	0.5200

Case V. Coils to be used in induction-motor stators of less than 2,500 volts having open slots and all the insulation is placed on the coil proper.

(1) Heat coil.
(2) Dip in varnish and bake.
(3) Tape coil, one-half lap, with one-inch linen tape, 0.006 inch thick.
(4) Heat coil.
(5) Dip in varnish and bake.
(6) Repeat (3).
(7) Repeat (4).
(8) Repeat (5).
(9) Envelop slot portion and straightaways with one piece of 0.010-inch fullerboard, two pieces of 0.010-inch oiled muslin and one piece of 0.010-inch fullerboard. Lap on top and fasten with varnish.
(10) Phase coils to have heads reinforced with one layer of 0.010-inch oiled muslin half lapped.

The effect of baking a coil after it has been dipped in varnish is to oxidize the varnish. When a coil is bulky it is impossible to oxidize the varnish on the inner parts and in this case it is better practice to impregnate such coils in a vacuum oven. The insulation relied upon to prevent breakdown from turn to turn and from layer to layer should be provided independently of the impregnating compound. The impregnating compound is used to save the insulation from destruction by eliminating all air and moisture, rather than reinforcing it. A baking varnish introduced by impregnating apparatus may in some cases be the better practice.

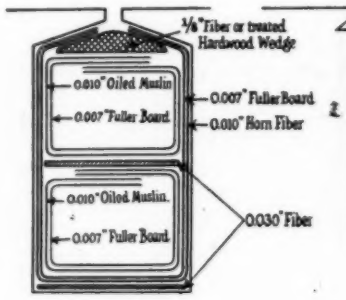


Fig. 163.

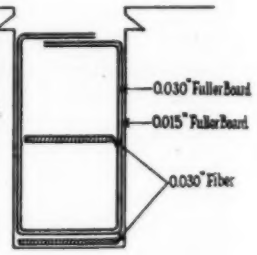


Fig. 164.

(*c*) Case I. Slot insulation for small low-voltage motors, such as the armature slots of small commutator motors and the stator slots of small motors. Fig. 162 shows a typical example.

Case II. Slot insulation for low-voltage motors of medium size; Fig. 163 shows a typical example.

Case III. Slot insulation for a voltage between 500 and 2,500 when part of the insulation is placed in the slot and part in the coil. Fig. 164 shows a typical example.

(*d*) When the coils are placed in the slots, the insulation between the upper and lower layer in the heads or legs of the windings is usually reinforced by placing two layers of 0.010-inch oiled muslin between the layers.

After the entire stator or rotor is wound and connected the leg portions of the coils are given one coat of varnish and

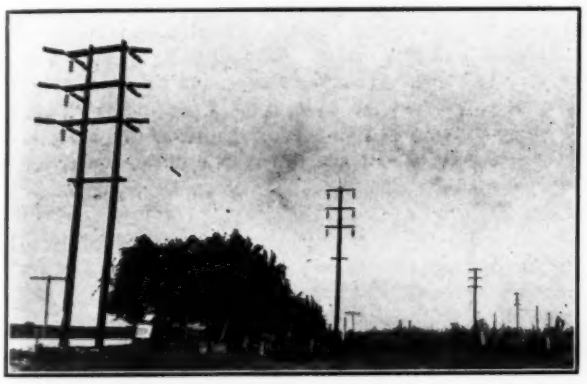
baked. The final step usually is to varnish with an oilproof finishing varnish.

When the machine is intended for operation in a damp atmosphere or when acid fumes will be present it is necessary to apply several extra dips in varnish, both to individual coils and to the finished winding, three or more such dips being necessary, depending on the particular conditions of operation. After dipping, each coat of varnish must be thoroughly oxidized by proper baking.

(To be concluded.)

Special Pole-Line Construction to Insure Continuous Service.

The accompanying illustration shows a special junction pole type of construction used by the Texas Power & Light Company on the line the company is building from Jenkins and Trinity Heights to Forney and Terrell. The line coming in from the right comes from Trinity Heights and the one from the left comes from Jenkins. Both lines are dead-ended at the point shown. Ordinarily both lines operate in parallel, but in case of trouble on either line a switch a short piece ahead is operated and the line which



Special Pole-Line Junction.

is not in trouble continues to serve the towns in question.

This is just another case which illustrates the care which is being exercised by public utilities to provide continuous service.

How to Figure the Pull Which Any Pole Will Withstand.

A recent report of the United States Forest Service gives the following formula for figuring the pull a pole will withstand:

$$\text{Top reaction at maximum load} = \frac{0.098 \times D^3 \times M}{L}$$

D is the diameter of the pole at the ground line, in inches.

M is the average modulus of rupture, or the measure of the ultimate strength or breaking load of the pole.

L is the length, in inches, between the ground line and the point where the strain is applied, for instance, crossarm contact.

0.098 is a constant which the Forest Service has evolved through investigation; 0.098 D^3 is often known as the section modulus of a solid circle.

The "top reaction at maximum load" is the pull necessary to break the pole.

The publishing of this formula makes it a simple matter for one to figure the pull which any pole will stand. Using, as an example, an eight-inch 40-foot western red cedar pole, Class B specifications of the National Electric Light Association, or the specifications of the American Telephone & Telegraph Company (pole set six feet in the ground), it figures out as follows:

This pole would have a 38-inch circumference six feet from the butt end, which would give it a diameter slightly over 12 inches at the ground line. The pull is applied at the crossarm or, say, five feet from the top. L in this case is 40—6—5 or 29 feet. 6,910 pounds is the average modulus of rupture of western red cedar poles, as shown by the United States Forest Service report L31-A. In this case, therefore,

$$\text{Top reaction at maximum load} = \frac{0.098 \times 12^3 \times 6{,}910}{29 \times 12} = 3{,}362 \text{ pounds.}$$

Working out the formula shows that a western red cedar pole conforming to the National Electric Light Association specifications will withstand a strain of 3,362 pounds. The high strain which this formula proves that a western red cedar pole will withstand is very interesting to pole buyers. It is rarely, if ever, that any such pull as this is required in actual service. It shows that western red cedar poles have more than the required strength necessary to stand up under the severest strain met with in actual everyday service.

Among the Contractors.

The B. & H. Electric Company, Yankton, S. D., nas secured the contract for the installation of an $11,000 electric-lighting plant at Tabor, S. D.

Harry Shaffer has taken over the entire business of the Quality Electric Shop, Orange, Cal., formerly under the ownership of Shaffer & Millings.

The Chloride Electric Supply Company, composed of C. H. Weidman and J. E. Terral, has opened for business in Chloride, Ariz., with a complete line of electrical appliances, etc.

The Albert Sechrist Manufacturing Company, of Denver, Colo., has been awarded the contract for installation of the lighting fixtures in the new Weld County courthouse at Greeley, Colo.

The Economy Electric Company, recently incorporated in Massachusetts, will conduct a general contracting and sales business at 30 Foster street, Worcester, having leased two floors of a building. Peter A. Coghlin, formerly with the Coghlin Electric Company, is president and treasurer. He has been in the electrical business nearly 20 years, having been graduated from the Worcester Polytechnic Institute prior to his first entrance into business, which was with the Page Electric Company, Worcester, Mass.

The Topeka (Kans.) Electric Company has recently provided aerials and other equipment of wireless time-receiving outfits for the Santa Fe Watch Company, Topeka. This is the second outfit to be installed in Topeka, the first having been in satisfactory operation for three months. The company assembles the outfits from various sources, does the wiring and erects the aerials. The company has added a Prestolite storage-battery service station, increasing its shop equipment to care for the battery business.

The Pierce Electric Company, 215 Randolph Street, Chicago, Ill., has been awarded the contract for all the electrical work in the new paper mill being built by the Chicago Mill & Lumber Company, adjoining its present large box factories and lumber plant at Sangamon Street and the north branch of the Chicago River. This paper mill is probably the first to be built in a large city. It will utilize waste products of the lumber company and will require the installation of a large number of electric motors.

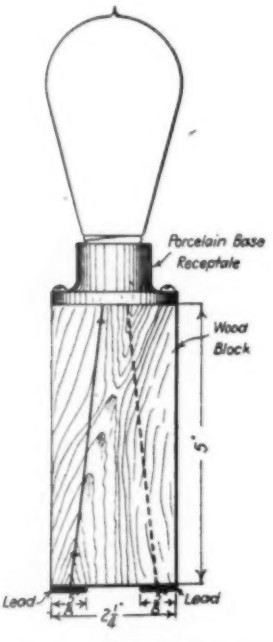
DOLLAR WIRING KINKS

Every reader is invited to contribute to this page. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Test Lamp for Panelboards.

Herewith is a diagram of a simple test lamp that I have found very handy in testing for blown fuses on panelboards. It consists of a lamp receptacle mounted on a wood block with lead terminals tacked to its other end. The wires are soldered to these lead blocks and can be run through holes made through the block or put into grooves cut into the opposite faces, as shown. If the lead terminals are made of the size shown, this arrangement prevents getting a short-circuit, as they are not long enough to reach from one circuit terminal to the other on the board. If desired, the lamp may be mounted in a separate socket instead of on the block and connected to the latter by a short piece of lamp cord.

W. E. Bumpas.

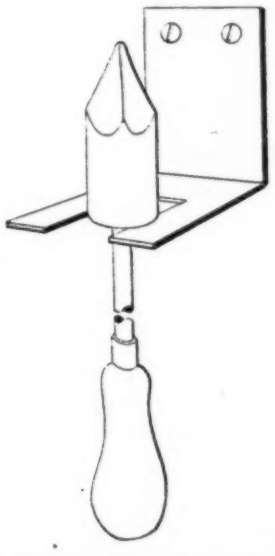


Handy Mounting of Test Lamp for Panelboards.

Handy and Safe Support for Soldering Iron.

When working at the bench I find that a very handy and safe method of disposing of a hot soldering iron after using is to hang it in a slotted bracket such as that shown in the accompanying sketch. Take a piece of sheet-metal about 5 inches long by 2 inches wide and about $\frac{1}{16}$-inch thick. Punch a couple of holes near one end and in the opposite end make a slot about ½-inch wide with a cold chisel. Now bend it in the middle at right angles. Screw it to the wall. If the bracket is mounted against a wood partition or post, a sheet of asbestos between the bracket and wood surface should be used to remove any danger of fire. Hanging up the hot iron in such a bracket puts it out of harm's way and avoids danger of burning the fingers or scorching the bench.

Harry B. Stillman.



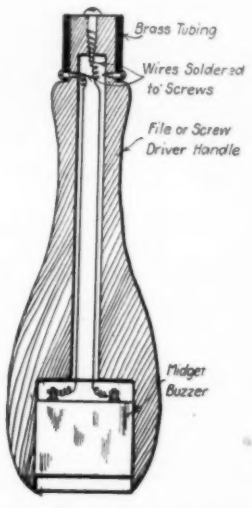
Simple Support for Keeping Soldering Iron Out of Harm.

Solid Neutral for Combination Switch and Cutout.

As a rule all three-wire combination switches and cutouts of the plug-fuse type have sockets for all three fuse plugs. Such a switch with cutout is used as a main service switch. Rule 23*a* of the National Electrical Code requires that cutouts must not be placed in any permanently grounded service wire, which means that the neutral of three-wire, but not three-phase, services must be made solid. I find that in the type switch referred to, it is very easy to eliminate the neutral fuse by taking out the center brass screw and washer from the middle fuse socket and removing the mica insulator therein. Now replace the brass screw and washer and you have solid electrical contact. M. Braun.

Simple Fixture Test Device.

A very simple and handy test device for fixture hangers to carry with them can be made from an old file or screwdriver handle. A short piece of three-fourths-inch tubing is driven onto the end of the handle in place of the usual ferrule. At the other end of the handle fasten a midget buzzer. Connect one terminal of this by means of wire soldered to the ferrule or thimble. Connect the other terminal to an ordinary wood screw driven into the center of the open wood end of the handle in the middle of the ferrule, the wire being carried through a quarter-inch hole drilled through the middle of the handle and soldered to the middle screw. These solder connections are desirable in order to prevent the wires from pulling off. To use this all that is required is to secure a battery, for instance the battery connected with the bell system in the house, connect it to the two wires feeding the cutouts on the circuit and then screw in the plug fuses. By pushing this simple test device into each socket on the circuit the buzzer will sound if the line is clear. W. Morris.



Compact and Handy Device for Testing Fixtures.

Skinning Weatherproof Wire.

All persons who have to "skin" weatherproof wire, especially the larger sizes, have probably had trouble, caused by the waterproofing compound sticking to the knife, and so gumming it that it was impossible to cut. When on this kind of a job I carry a little flat emery stick which I made myself by putting hot glue and then fine emery dust on a stick about 5 by 2 by ¼ inch. I then can quickly clean my knife whenever needed. Of course, one can buy emery sticks, but the size which I made fits the pocket better than any I have seen. A. S. Nickerson.

NEW APPLIANCES

A Weekly Review of the Latest Developments and Current Information Respecting Electrical and Kindred Mechanical Appliances

Improved Clamps for Attaching Conduit.

A simple, but valuable, improvement in conduit clamps has been made in the new special Adapticlamps just placed on the market by the Adapti Company, Cleveland, Ohio. These are provided with a special offset at the end of the clamp which acts as a lever, thus permitting the workman to draw up the conduit very closely to the surface to which it is being attached. By merely driving home

Adapticlamps for Rigid and Flexible Conduit.

the screw this quickly tightening leverage effect is obtained.

These Adapticlamps are made with a black enamel finish, unless otherwise specified. They are available in three sizes, for one-half-inch, three-quarter-inch and one-inch conduit. They will be found to facilitate the attachment of rigid or flexible conduit to either walls or ceilings, making a quicker, neater, and more secure job than the old-style clamps.

Reverse-Phase Relay of New Design.

In the constantly increasing efforts of power companies to afford all possible protection to life, machinery and manufactured product, the reverse-phase relay has been called upon to play an important part. These companies have been quick to take advantage of the protection thus afforded against the serious results often attendant upon alternating-current power motor reversals, particularly when these motors are used in connection with elevators, hoists, conveyors, cranes, machine tools and textile machinery. In fact, in some large cities the use of reverse-phase relays in this application has been made compulsory.

Among the common causes of accidental phase reversal are the interchanging of wires by power companies when repairs to cables are made that involve a temporary discontinuing of the service mains. This may also happen when additional switching apparatus is installed or when additional service wires are connected.

Protection is required for two conditions: first, where the motor operates normally in one direction only, and second, where the motor, under normal conditions, operates in either forward or a reverse direction by changing the phase rotation with a controller. In the first case the relay is installed as near the motor as possible, so that when current is thrown on the motor under unintentional reversed-phase conditions the relay operates, opens the motor switch and automatically cuts out the motor from the circuit. In the second case the relay is connected outside of the controlling apparatus of the motor and affords protection for reversals of phase between the controlling apparatus and the source of power supply.

The new reverse-phase relay illustrated is made in both circuit-opening and circuit-closing styles. Both types of contacts are equipped with toggles so arranged that there is no tendency for the contacts to open or close until the toggle has buckled, the contacts being then, by means of a small spring, quickly thrown to the desired position. The type of contacts required for any installation will depend on the method of tripping out the motor switch. When contactors alone are used, circuit-opening contacts are recommended. The circuit-opening contacts are hand reset. Circuit-closing relays are used in connection with a shunt trip on air or oil circuit-breakers. Contacts of either type are of strong construction and are protected by a dustproof cover.

The relay operates on the same principle as a squirrel-cage induction motor. The operating coils correspond to the stator and a hollow aluminum cylinder, connected to the contacts, corresponds to the rotor. The cylinder (plunger) does not rotate, but moves in a straight line, either up or down, depending upon the phase rotation. When one of the phases of the line is reversed, the plunger moves and operates the circuit-opening or circuit-closing contacts.

Relays can be furnished for two-phase or three-phase service with either curent or potential windings, depending upon the amount of current and the voltage of the circuit. Current windings, which will cause the relays to operate on phase reversal at 70 per cent of normal current, are supplied for the following conditions:

For circuits up to and including 100 amperes and 550 volts, connected in series with the line; for similar circuits, connected in the secondaries of current transformers; for circuits of 600 volts and above at all currents, connected in the secondaries of current transformers.

Potential windings are supplied for circuits up to and including 550 volts, connected directly across the line; for circuits above 550 volts, connected to the secondaries of potential transformers. These coils are furnished with external resistances of the proper value for the different voltages.

Reverse-phase relays as described and illustrated herein are manufactured by the General Electric Company.

Instantaneous Circuit-Opening Reverse-Phase Relay With Hand-Reset Contacts, Top Cover Removed.

Premier Automatic Electric Vulcanizer for Repairing Automobile Tires and Household Rubber Articles.

The extraordinary development of the automobile business has stimulated the demand for a simple and effective vulcanizer by means of which repairs of pneumatic tires can be safely and properly made. Of the various types of such devices now on the market, those using gasoline or alcohol for providing

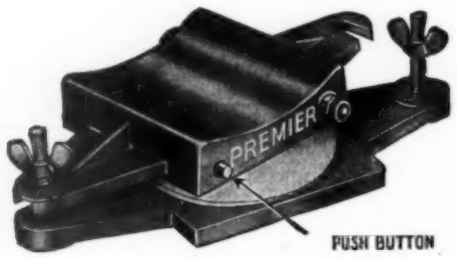


Fig. 1. Automatic Electric Vulcanizer.

the heat are a serious fire hazard in any garage and are the cause of increasing the insurance rate above that which could be secured if no open-flame devices were employed. Another disadvantage of the gasoline vulcanizer is that it is almost impossible to get exactly the right amount of heat, many tires being spoiled from excessive or insufficient heating.

The peculiar advantage of electric heat has suggested the development of an electric vulcanizer which not only absolutely eliminates the dangers connected with other methods, but, through a simple and ingenious means, insures securing exactly the proper heat necessary to do the work, and no more. The little appliance illustrated herewith, and known as the Premier automatic electric vulcanizer, has been developed primarily for use in vulcanizing pneumatic tires, both inner tubes and outer casings. However, as will be shown further on, it also is adaptable to the vulcanizing of almost any rubber appliance.

The device is very compact, the No. 1 size being easily held in the hand. It consists of a lower plate or base on which rests as asbestos disk. Over this is placed a cover plate which is held down by two clamping thumb screws at the ends. It contains the electric heating element (made of Nichrome wire) and an automatic switch therefor. The device is built on the principle of supplying the three necessary factors which are required for effective vulcanization, which are the application of the proper temperature of heat, application thereof for a certain definite time, so as to effect the necessary cure, and application of sufficient pressure to insure making a smooth and thorough job. All these three factors are provided in this simple device. The pressure is obtained by means of the thumb nuts and the required temperature is obtained by such a design of the heating element as will produce the necessary heat without liability of scorching. This required amount of heat is assured by means of an automatic thermostatic switch, which has been properly regulated and sealed; it includes a small red button protruding from one side. In

Fig. 2. Electrically Vulcanizing An Inner Tube.

starting vulcanizing, this button is pushed in to close the switch. As soon as the proper degree and volume of heat has been developed to secure thorough vulcanization this switch is automatically opened, thus preventing spoilage.

In operation for vulcanizing inner tubes of tires, the tube is placed in the manner shown in Fig. 2, current being applied by pressing the button, which later automatically opens the circuit when the work is finished; usually this takes about 20 minutes for a gradual and thorough penetration of the heat. For repairing the outer casings, the outfit is clamped against the casing without removing the latter from the wheel. For this purpose special clamping chains are provided. The operation in this case is similar, but the curved surface shown on top in Fig. 1 is used against the tire. For repairing any other object, such as a rubber glove or rubber hot-water bottle, the device is placed between the two plates as shown in Fig. 3.

This latter view shows the simplicity of using the device for various purposes of a domestic and miscellaneous character. For example, as soon as a rubber glove or ordinary hot-water bottle springs a small leak it is practically worthless; by means of this simple vulcanizer it can be easily and quickly repaired to be as good as new. This vulcanizer has been used for repairing rubber-soled tennis and gymnasium shoes and other rubber articles which have been cut or punctured. Physicians and hospitals find it a very convenient means for keeping their rubber gloves, mats and various other rubber appliances used intact and in working condition.

Fig. 3. Vulcanizing a Rubber Glove.

This device is made for various voltages, the most common being 110 volts; it can also be secured for operation on as low as six or 12 volts for connection to automobile ignition and starting batteries. The 110-volt type consumes only 0.6 ampere or about 65 watts. The outfit, complete with attachment cord and plug, simple tools for use in rubber repairing, and with rubber compound and all necessary accessories, sells complete at retail for only $3.50. It is manufactured by the Premier Electric Company, 4032-4042 Ravenswood Avenue, Chicago, Ill. The outfit is patented and guaranteed by the manufacturer.

Hughes Electric Bake Ovens.

The excellent results obtained with electric bake ovens in bakeries, restaurants, hotels and the kitchens of large institutions have attracted much attention to this type of oven and aroused interest in its construction and operation. The accompanying illustration shows the construction of such an oven, this being Hughes electric oven No. 220, which has a capacity of 120 one-pound loaves of bread or 12 standard roll pans, each 18 by 26 inches in size. This oven has three compartments.

Polyphase Motor Windings—XI

By Justin Lebovici

Previous installments of this article have dealt with two-layer and single-layer windings, the details of open and closed lap and wave windings being discussed and illustrated and numerical examples worked out. In the last installment it was shown how, by changing the number of poles, windings may be adapted to two speeds. In this installment rotor windings for two-speed induction motors and short-circuited rotor windings are considered and a study made of insulation. Next week the testing of insulation and the mechanical design of coils will conclude the series.

Rotor Windings for Two-Speed Induction Motors.

The rotors of two-speed induction motors are generally of the squirrel-cage type, since this type of rotor can be used in a given stator independently of the number of poles of the stator. One objectionable feature of this arrangement is the fact that if the rotor end-ring resistance is designed to give a high starting torque at the low speed, the slip at the high speed will be too large, resulting in a low efficiency. To avoid this, the end-ring resistance may be selected so as to fulfill the starting requirements at low speed, and at the same time the rotor bars will be provided with equipotential connections

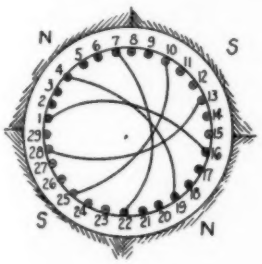


Fig. 148.

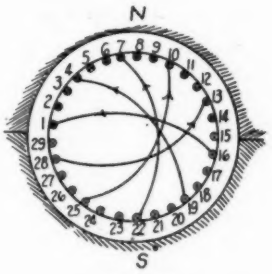


Fig. 149.

which are not effective at the low speed but become effective in lowering the rotor resistance when the speed is changed. The bars connected in this manner need not necessarily be of exactly the same potential at the low speed but should be of nearly the same potential.

Example No. 51.

A squirrel-cage rotor having 29 bars is placed in a stator arranged for four or two poles. Fig. 148 shows the condition for the low speed, or four poles, and Fig. 149 shows the conditions when the stator is changed so as to give high speed, or two poles. In Fig. 148 it will be seen that points 4 and 19, for example, are of nearly the same potential, hence very little current will flow through this connection, and most of the current will flow through the high-resistance winding from bar 4 toward bars 10 and 26 at the instant shown in Fig. 148. After the stator connections have been changed to give two poles, the difference in potential between points 4 and 19 becomes great and most of the current will flow through this connection, thus greatly reducing the resistance of the winding and reducing the slip.

Another method of increasing the resistance of the rotor winding during the starting period at the low speed consists in the use of a phase winding with three slip rings and resistances connected between slip rings the same as in an ordinary slip-ring motor. These external resistances are used only with the low-speed stator connection, the slip rings being short-circuited when the motor is changed to the high-speed connection.

Figs. 150 and 151 represent, respectively, the low-speed (2*P* poles) and the high-speed (*P* poles) connections of a multipolar rotor winding. It has been explained in connection with the two-speed stator windings how the six sections marked 1_s, 1_r, etc., in Fig. 150 are obtained, starting from a continuous wave or lap winding.

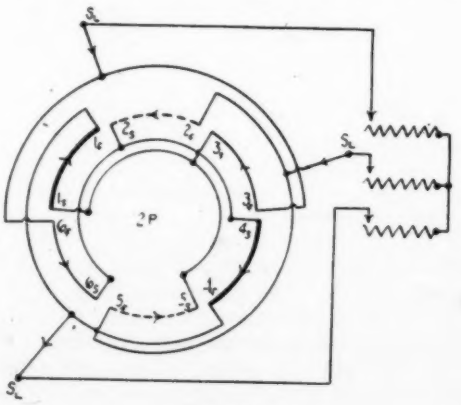


Fig. 150.

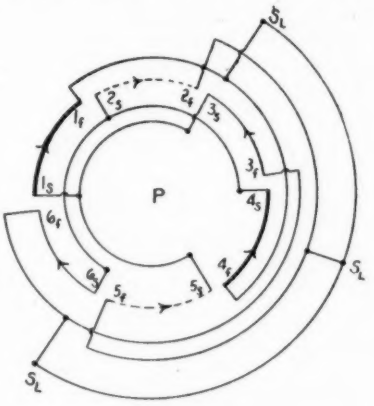


Fig. 151.

Figs. 152 and 153 show the same connections as in Figs. 150 and 151 and the change in connections may be more easily noted.

Example No. 52.

Assume a three-phase, 45-slot, 45-coil rotor winding. The stator winding is connected to give 4 and 8 poles and the rotor is to be connected to correspond with the stator. The rotor winding will be connected to three slip rings, as an external resistance box will be used in starting. We have

$Z=45 \quad S=90 \quad p_1=4 \quad p_2=2 \quad n=3$

$Z=(\text{whole number}\times p)+1=22\times 2+1=45$

$Z=(\text{whole number}\times n)=15\times 3=45$

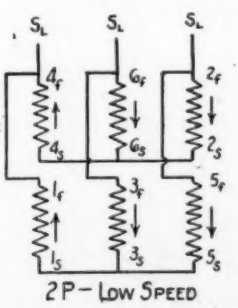


Fig. 152.

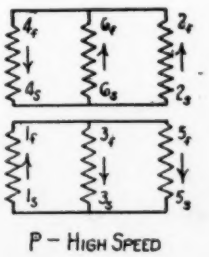


Fig. 153.

Since $S/6=90/6=15$ is an odd number, we will divide the winding into alternate sections of 16 and 14 coil sides each.

$\tau_h=90/4=22\frac{1}{2}$ $\tau_l=90/8=11+\frac{1}{4}$ $(\tau_h+\tau_l)/2=16.9$

$y_h=y_1+y_2=(90\pm2)/2=44$

$y_1=17$ $y_2=27$

We can now lay out Table XLIX and Figs. 154 and 155, in which the six resulting sections are connected as per Figs. 152 and 153 respectively. The direction of the currents for one instant is given and the change in the number of poles is easily traced. It should be noted that the current in the rotor is obtained by induction from the stator and its direction for a given instant depends on the stator connections.

resistances must be transferred from leads A_1, B_1, C_1 to leads A, B, C in Figs. 156 and 157 when changing from low to high speed. The connection selected for these figures is the same as given in Fig. 127.

Short-Circuited Rotor Windings.

In case the speed of an induction motor need not be varied, or the resistance of the rotor winding need not be increased at starting, we are free to increase the number of rotor phases and permanently short-circuit these phases.

(*a*) The common squirrel-cage winding, having one bar in each slot and these bars short-circuited by end rings of a proper section and material to provide a specified starting torque, is

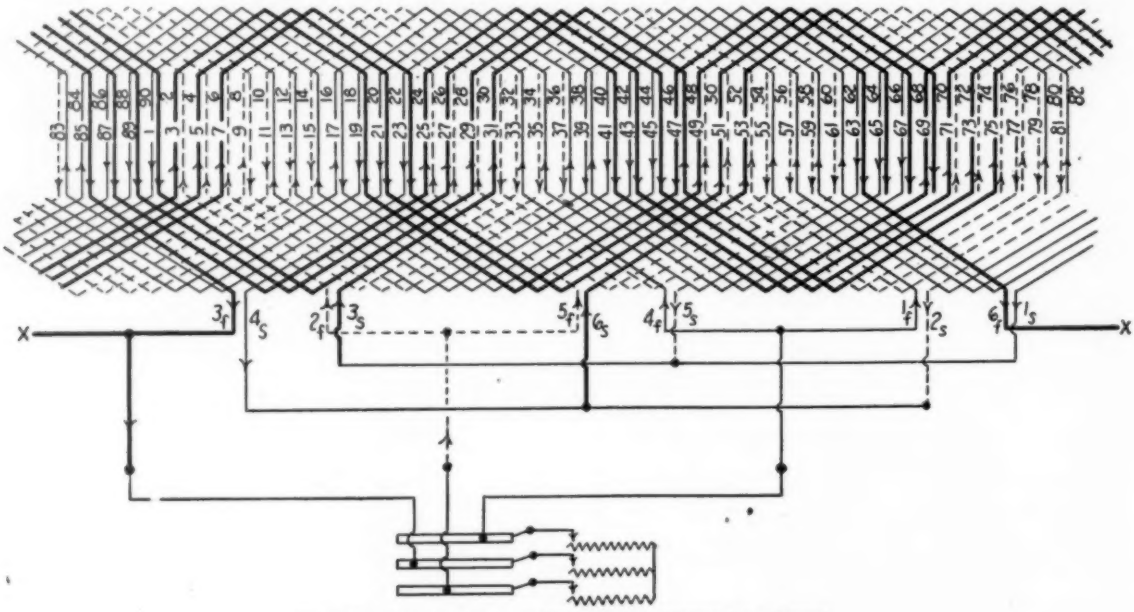


Fig. 154.—Connections for Eight Poles, Giving Low Speed.

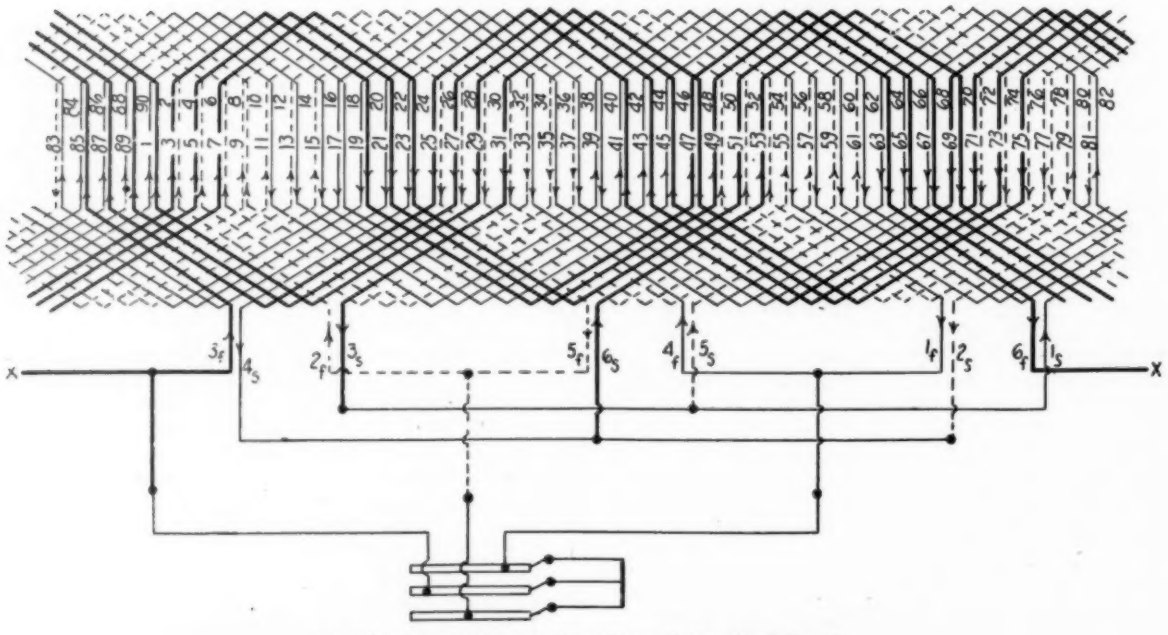


Fig. 155.—Connections for Four Poles, Giving High Speed.

In case it is necessary to reduce the speed of the motor below normal speed with high and low-speed connections, two independent rotor windings can be used, each being wound for a number of poles corresponding to the number of poles of the stator winding, or any of the schemes previously given in connection with two-speed stator windings can be resorted to. The rotor must be provided with six slip rings and the external generally used in medium-sized polyphase motors and in small single-phase motors of the "split-phase" type. The electrical connection between the bars and end rings is obtained by means of solder, rivets, screws, mechanical pressure between bars and rings, or a combination of solder and one of the above means. In some motors the rings are cast around the bars, or the bars and rings are welded together. In large sizes and in cases

where the starting conditions are severe and repeated at short intervals, the squirrel cage being subjected to expansions and contractions, it is found advisable to depart from the squirrel-cage type of winding.

(*b*) Single-phase motors are often started as repulsion motors, this requiring a direct-current armature for starting. In order to obtain the short-circuited polyphase rotor winding after the motor has come up to speed, it is common practice to

TABLE XLIX.

1	18	45	62
89	16	43	60
87	14	41	58
85	12	39	56
83	10	37	54
81	8	35	52
79	6	33	50
77	4	31	48
75	2	29	46
73	90	27	44
71	88	25	42
69	86	23	40
67	84	21	38
65	82	19	36
63	80	17	34
61	78	15	32
59	76	13	30
57	74	11	28
55	72	9	26
53	70	7	24
51	68	5	22
49	66	3	20
47	64		

short-circuit all the commutator bars, thus obtaining a short-circuited polyphase winding with as many phases as there are commutator bars per pole.

(*c*) To overcome the difficulties inherent to the mechanical construction of the squirrel cage, a short-circuited barrel winding is sometimes used. Fig. 158 represents such a winding, consisting of coils connecting bars spaced approximately one pole pitch apart. The coils are made by slotting a strip of copper as shown in Fig. 159 and spreading the same, as shown in Fig. 160.

Example No. 53.

Fig. 158 shows the winding arrangement of a four-pole rotor short-circuited barrel winding, having 12 slots and 12 coils.

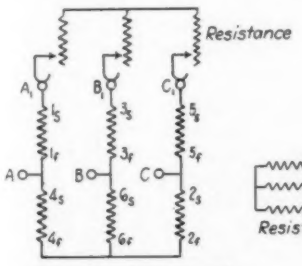


Fig. 156.—Low Speed.

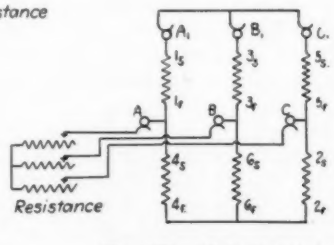


Fig. 157.—High Speed.

Insulation.

Since the greatest part of the breakdowns occurring in electrical machinery is due to failure of the insulation, it is important that the insulation should be made as safe as possible, even to the extent of sacrificing other considerations in the design of the machine. Much time could be devoted to a discussion of this subject, but since numerous books and papers on the subject are available, we shall limit ourselves here to a few examples giving the method of insulating small and medium-sized motors according to present-day practice.

In general it may be stated that enough insulation has to be provided to prevent breakdown due to the difference in potential existing between the turns of the winding itself and between the coils and surrounding iron or "to ground." The insulating material should be such that it can undergo handling without mechanical injury. In selecting the insulation the degree of heating of the machine must also be kept in mind. The final step in the insulation of the winding is to give it a varnish treatment giving a smooth finish to allow for

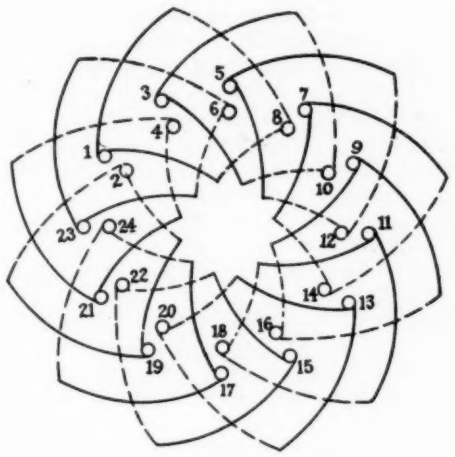


Fig. 158.

contact with oil due to oil thrown from the bearings, or other causes and to prevent short-circuiting due to the accumulation of dust and dirt while in service.

Some manufacturers prefer to put most of the insulation in the slot (in the form of a slot cell) while others prefer to place the most of the insulation directly on the coils. The latter method is preferable, since it enables the customer to obtain, from the manufacturer, spare coils ready for use in case repairs are necessary, and because each coil may be tested before it is placed in the machine.

We have the following to consider:

(*a*) The insulation of the individual conductors.
(*b*) The insulation of the coils.
(*c*) The slot insulation.
(*d*) The finishing insulation.

(*a*) For windings made of wire larger than No. 16 B&S, double-cotton-covered wire is the cheapest and most used. When wire smaller than No. 16 is used it is advisable to use a single-cotton-enamel-covered wire due to the improvement in the copper space-factor. For very small wire the cotton covering takes up too much space, hence double-silk-covered or single-silk-enamel-covered wire, although more expensive, may be used to advantage. Large rectangular copper, wrapped with linen tape, is used in coils having a few turns of large cross-section. The taping of these conductors may be done by hand or by a taping machine.

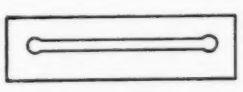


Fig. 159.

Fig. 160.

(*b*) Coils used with open slots are completely taped and finished before being placed in the machine.

Coils used with semi-inclosed slots have only the "heads" taped, this taping being done either before or after the coils are placed in the machine. The tape used is usually 0.75 to 1 inch wide with a thickness of 0.006 to 0.009 inch. The coils separating the phase groups in polyphase machines should be taped with one or two layers of oiled muslin in addition to the linen tape. In all cases the coils are wound and formed before the insulation is applied.

A few examples of coil insulation follow.

Case I. Coils to be used in a low-voltage machine having open slots, and the bulk of the insulation is placed in the slot proper. In this case it is sufficient to tape the coil all over with 0.75-inch linen tape, 0.006 to 0.008 inch thick. It is advisable to dip the coil in varnish and bake before the tape is applied. The coils separating different phase groups in polyphase machines should have the heads reinforced with one or two layers of 0.75-inch oiled muslin or empire cloth, 0.006 to 0.009 inch thick before the linen tape is applied. The wrapping of the tape should be done so that the tape is half lapped.

Case II. Coils to be used in low-voltage machines with open slots and most of the insulation is to be placed on the coil proper.

(1) Tape skinned places with silk tape.
(2) Place paper between layers.
(3) Heat coil at least one-half hour at 100 degrees centigrade to expel all moisture.
(4) Dip in varnish and bake according to varnish manufacturer's specification.
(5) Tape with oiled muslin on heads and about one inch from bend.
(6) Place cotton sleeving, of proper color, over the leads.
(7) Tape all over with 0.75-inch linen tape, one-half lap. Tape to be about 0.006 to 0.008 inch thick.

Case III. Coils to be used in 2,200-volt induction-motor stator having open slots and slot proper is carefully lined.

(1) Heat coil to expel moisture.
(2) Dip in varnish and bake.
(3) Tape with two layers, one-half lap, of one-inch oiled muslin 0.009 inch thick.
(4) Tape with one layer, one-half lap, of 0.75-inch linen tape 0.006 inch thick.
(5) Heat coil to expel moisture.
(6) Dip in varnish and bake.

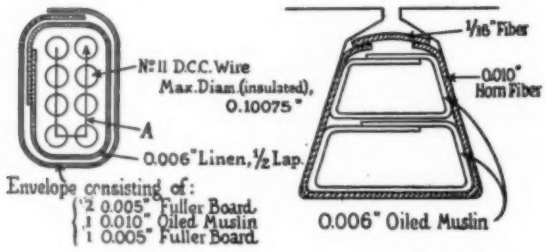


Fig. 161.

Fig. 162.

Case IV. Coils to be used in induction-motor stators, for 500 volts or less, having open slots and with all insulation placed on the coil proper.

(1) Heat coil to expel moisture.
(2) Dip in varnish and bake.
(3) Tape coils one-half lap, with 0.006-inch linen tape one inch wide.
(4) Heat coil to expel moisture.
(5) Dip in varnish and bake.
(6) Envelop slot portion and straightaways with one piece of 0.005-inch fuller board, one piece of 0.010-inch oiled muslin, and two pieces of 0.005-inch fuller board. Fasten the ends with shellac.
(7) Phase coils (coils separating two phases) to have heads reinforced with two layers of 0.010-inch oiled muslin, half lapped.

In calculating the space to be allowed for the insulation the following allowances are made. Allowance for increase in diameter of insulated wire when dipped in varnish is 0.003 inch, for No. 10 B&S or larger, and 0.002 inch for smaller than No. 10. Allowance for increase in width or depth of coil when dipped in varnish is 0.010 inch. These allowances should be taken as only approximate since they refer to one particular grade of varnish, and should be modified for other grades of varnish.

Example No. 54.

Assume a 220-volt induction-motor stator coil to be insulated as per Case IV. The coil has eight turns of No. 11 B&S double-cotton-covered wire. Fig. 161 shows a section through the slot portion of the coil. The arrow *A* shows the rotation in which the wire is wound to avoid cross overs.

	Width of Coil in Inches	Depth of Coil in Inches
Space for wire	0.2015	0.4030
Increase due to varnish on wires	0.0040	0.0080
Linen tape, one-half lap	0.0240	0.0240
Increase due to varnish on coil	0.0100	0.0100
Envelope	0.0500	0.0750
Total	0.2895	0.5200

Case V. Coils to be used in induction-motor stators of less than 2,500 volts having open slots and all the insulation is placed on the coil proper.

(1) Heat coil.
(2) Dip in varnish and bake.
(3) Tape coil, one-half lap, with one-inch linen tape, 0.006 inch thick.
(4) Heat coil.
(5) Dip in varnish and bake.
(6) Repeat (3).
(7) Repeat (4).
(8) Repeat (5).
(9) Envelop slot portion and straightaways with one piece of 0.010-inch fullerboard, two pieces of 0.010-inch oiled muslin and one piece of 0.010-inch fullerboard. Lap on top and fasten with varnish.
(10) Phase coils to have heads reinforced with one layer of 0.010-inch oiled muslin half lapped.

The effect of baking a coil after it has been dipped in varnish is to oxidize the varnish. When a coil is bulky it is impossible to oxidize the varnish on the inner parts and in this case it is better practice to impregnate such coils in a vacuum oven. The insulation relied upon to prevent breakdown from turn to turn and from layer to layer should be provided independently of the impregnating compound. The impregnating compound is used to save the insulation from destruction by eliminating all air and moisture, rather than reinforcing it. A baking varnish introduced by impregnating apparatus may in some cases be the better practice.

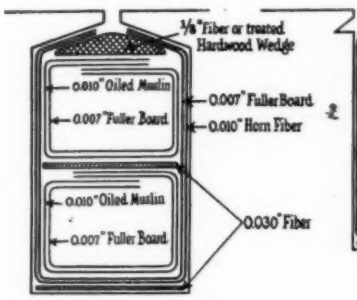


Fig. 163.

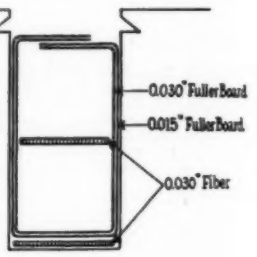


Fig. 164.

(*c*) Case I. Slot insulation for small low-voltage motors, such as the armature slots of small commutator motors and the stator slots of small motors. Fig. 162 shows a typical example.

Case II. Slot insulation for low-voltage motors of medium size; Fig. 163 shows a typical example.

Case III. Slot insulation for a voltage between 500 and 2,500 when part of the insulation is placed in the slot and part in the coil. Fig. 164 shows a typical example.

(*d*) When the coils are placed in the slots, the insulation between the upper and lower layer in the heads or legs of the windings is usually reinforced by placing two layers of 0.010-inch oiled muslin between the layers.

After the entire stator or rotor is wound and connected the leg portions of the coils are given one coat of varnish and

baked. The final step usually is to varnish with an oilproof finishing varnish.

When the machine is intended for operation in a damp atmosphere or when acid fumes will be present it is necessary to apply several extra dips in varnish, both to individual coils and to the finished winding, three or more such dips being necessary, depending on the particular conditions of operation. After dipping, each coat of varnish must be thoroughly oxidized by proper baking.

(To be concluded.)

Special Pole-Line Construction to Insure Continuous Service.

The accompanying illustration shows a special junction pole type of construction used by the Texas Power & Light Company on the line the company is building from Jenkins and Trinity Heights to Forney and Terrell. The line coming in from the right comes from Trinity Heights and the one from the left comes from Jenkins. Both lines are dead-ended at the point shown. Ordinarily both lines operate in parallel, but in case of trouble on either line a switch a short piece ahead is operated and the line which

Special Pole-Line Junction.

is not in trouble continues to serve the towns in question.

This is just another case which illustrates the care which is being exercised by public utilities to provide continuous service.

How to Figure the Pull Which Any Pole Will Withstand.

A recent report of the United States Forest Service gives the following formula for figuring the pull a pole will withstand:

$$\text{Top reaction at maximum load} = \frac{0.098 \times D^3 \times M}{L}$$

D is the diameter of the pole at the ground line, in inches.

M is the average modulus of rupture, or the measure of the ultimate strength or breaking load of the pole.

L is the length, in inches, between the ground line and the point where the strain is applied, for instance, crossarm contact.

0.098 is a constant which the Forest Service has evolved through investigation; 0.098 D^3 is often known as the section modulus of a solid circle.

The "top reaction at maximum load" is the pull necessary to break the pole.

The publishing of this formula makes it a simple matter for one to figure the pull which any pole will stand. Using, as an example, an eight-inch 40-foot western red cedar pole, Class B specifications of the National Electric Light Association, or the specifications of the American Telephone & Telegraph Company (pole set six feet in the ground), it figures out as follows:

This pole would have a 38-inch circumference six feet from the butt end, which would give it a diameter slightly over 12 inches at the ground line. The pull is applied at the crossarm or, say, five feet from the top. L in this case is 40—6—5 or 29 feet. 6,910 pounds is the average modulus of rupture of western red cedar poles, as shown by the United States Forest Service report L31-A. In this case, therefore,

$$\text{Top reaction at maximum load} = \frac{0.098 \times 12^3 \times 6{,}910}{29 \times 12} = 3{,}362 \text{ pounds.}$$

Working out the formula shows that a western red cedar pole conforming to the National Electric Light Association specifications will withstand a strain of 3,362 pounds. The high strain which this formula proves that a western red cedar pole will withstand is very interesting to pole buyers. It is rarely, if ever, that any such pull as this is required in actual service. It shows that western red cedar poles have more than the required strength necessary to stand up under the severest strain met with in actual everyday service.

Among the Contractors.

The B. & H. Electric Company, Yankton, S. D., nas secured the contract for the installation of an $11,000 electric-lighting plant at Tabor, S. D.

Harry Shaffer has taken over the entire business of the Quality Electric Shop, Orange, Cal., formerly under the ownership of Shaffer & Millings.

The Chloride Electric Supply Company, composed of C. H. Weidman and J. E. Terral, has opened for business in Chloride, Ariz., with a complete line of electrical appliances, etc.

The Albert Sechrist Manufacturing Company, of Denver, Colo., has been awarded the contract for installation of the lighting fixtures in the new Weld County courthouse at Greeley, Colo.

The Economy Electric Company, recently incorporated in Massachusetts, will conduct a general contracting and sales business at 30 Foster street, Worcester, having leased two floors of a building. Peter A. Coghlin, formerly with the Coghlin Electric Company, is president and treasurer. He has been in the electrical business nearly 20 years, having been graduated from the Worcester Polytechnic Institute prior to his first entrance into business, which was with the Page Electric Company, Worcester, Mass.

The Topeka (Kans.) Electric Company has recently provided aerials and other equipment of wireless time-receiving outfits for the Santa Fe Watch Company, Topeka. This is the second outfit to be installed in Topeka, the first having been in satisfactory operation for three months. The company assembles the outfits from various sources, does the wiring and erects the aerials. The company has added a Prestolite storage-battery service station, increasing its shop equipment to care for the battery business.

The Pierce Electric Company, 215 Randolph Street, Chicago, Ill., has been awarded the contract for all the electrical work in the new paper mill being built by the Chicago Mill & Lumber Company, adjoining its present large box factories and lumber plant at Sangamon Street and the north branch of the Chicago River. This paper mill is probably the first to be built in a large city. It will utilize waste products of the lumber company and will require the installation of a large number of electric motors.

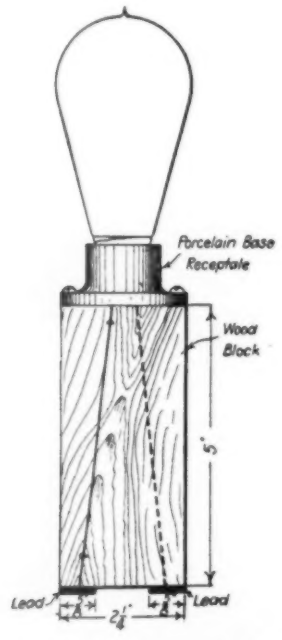
DOLLAR WIRING KINKS

Every reader is invited to contribute to this page. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Test Lamp for Panelboards.

Herewith is a diagram of a simple test lamp that I have found very handy in testing for blown fuses on panelboards. It consists of a lamp receptacle mounted on a wood block with lead terminals tacked to its other end. The wires are soldered to these lead blocks and can be run through holes made through the block or put into grooves cut into the opposite faces, as shown. If the lead terminals are made of the size shown, this arrangement prevents getting a short-circuit, as they are not long enough to reach from one circuit terminal to the other on the board. If desired, the lamp may be mounted in a separate socket instead of on the block and connected to the latter by a short piece of lamp cord.

W. E. Bumpas.

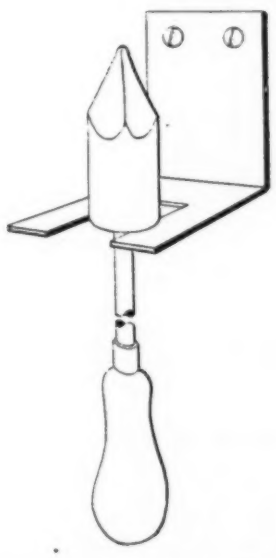


Handy Mounting of Test Lamp for Panelboards.

Handy and Safe Support for Soldering Iron.

When working at the bench I find that a very handy and safe method of disposing of a hot soldering iron after using is to hang it in a slotted bracket such as that shown in the accompanying sketch. Take a piece of sheet-metal about 5 inches long by 2 inches wide and about $\frac{1}{16}$-inch thick. Punch a couple of holes near one end and in the opposite end make a slot about ½-inch wide with a cold chisel. Now bend it in the middle at right angles. Screw it to the wall. If the bracket is mounted against a wood partition or post, a sheet of asbestos between the bracket and wood surface should be used to remove any danger of fire. Hanging up the hot iron in such a bracket puts it out of harm's way and avoids danger of burning the fingers or scorching the bench.

Harry B. Stillman.



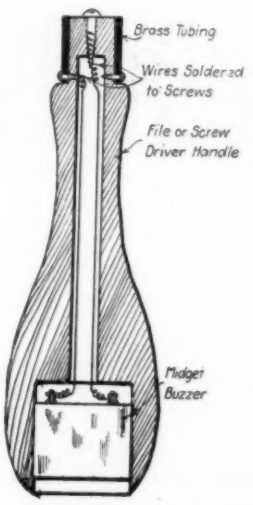
Simple Support for Keeping Soldering Iron Out of Harm.

Solid Neutral for Combination Switch and Cutout.

As a rule all three-wire combination switches and cutouts of the plug-fuse type have sockets for all three fuse plugs. Such a switch with cutout is used as a main service switch. Rule 23*a* of the National Electrical Code requires that cutouts must not be placed in any permanently grounded service wire, which means that the neutral of three-wire, but not three-phase, services must be made solid. I find that in the type switch referred to, it is very easy to eliminate the neutral fuse by taking out the center brass screw and washer from the middle fuse socket and removing the mica insulator therein. Now replace the brass screw and washer and you have solid electrical contact. M. Braun.

Simple Fixture Test Device.

A very simple and handy test device for fixture hangers to carry with them can be made from an old file or screwdriver handle. A short piece of three-fourths-inch tubing is driven onto the end of the handle in place of the usual ferrule. At the other end of the handle fasten a midget buzzer. Connect one terminal of this by means of wire soldered to the ferrule or thimble. Connect the other terminal to an ordinary wood screw driven into the center of the open wood end of the handle in the middle of the ferrule, the wire being carried through a quarter-inch hole drilled through the middle of the handle and soldered to the middle screw. These solder connections are desirable in order to prevent the wires from pulling off. To use this all that is required is to secure a battery, for instance the battery connected with the bell system in the house, connect it to the two wires feeding the cutouts on the circuit and then screw in the plug fuses. By pushing this simple test device into each socket on the circuit the buzzer will sound if the line is clear. W. Morris.



Compact and Handy Device for Testing Fixtures.

Skinning Weatherproof Wire.

All persons who have to "skin" weatherproof wire, especially the larger sizes, have probably had trouble, caused by the waterproofing compound sticking to the knife, and so gumming it that it was impossible to cut. When on this kind of a job I carry a little flat emery stick which I made myself by putting hot glue and then fine emery dust on a stick about 5 by 2 by ¼ inch. I then can quickly clean my knife whenever needed. Of course, one can buy emery sticks, but the size which I made fits the pocket better than any I have seen. A. S. Nickerson.

NEW APPLIANCES

A Weekly Review of the Latest Developments and Current Information Respecting Electrical and Kindred Mechanical Appliances

Improved Clamps for Attaching Conduit.

A simple, but valuable, improvement in conduit clamps has been made in the new special Adapticlamps just placed on the market by the Adapti Company, Cleveland, Ohio. These are provided with a special offset at the end of the clamp which acts as a lever, thus permitting the workman to draw up the conduit very closely to the surface to which it is being attached. By merely driving home

Adapticlamps for Rigid and Flexible Conduit.

the screw this quickly tightening leverage effect is obtained.

These Adapticlamps are made with a black enamel finish, unless otherwise specified. They are available in three sizes, for one-half-inch, three-quarter-inch and one-inch conduit. They will be found to facilitate the attachment of rigid or flexible conduit to either walls or ceilings, making a quicker, neater, and more secure job than the old-style clamps.

Reverse-Phase Relay of New Design.

In the constantly increasing efforts of power companies to afford all possible protection to life, machinery and manufactured product, the reverse-phase relay has been called upon to play an important part. These companies have been quick to take advantage of the protection thus afforded against the serious results often attendant upon alternating-current power motor reversals, particularly when these motors are used in connection with elevators, hoists, conveyors, cranes, machine tools and textile machinery. In fact, in some large cities the use of reverse-phase relays in this application has been made compulsory.

Among the common causes of accidental phase reversal are the interchanging of wires by power companies when repairs to cables are made that involve a temporary discontinuing of the service mains. This may also happen when additional switching apparatus is installed or when additional service wires are connected.

Protection is required for two conditions: first, where the motor operates normally in one direction only, and second, where the motor, under normal conditions, operates in either forward or a reverse direction by changing the phase rotation with a controller. In the first case the relay is installed as near the motor as possible, so that when current is thrown on the motor under unintentional reversed-phase conditions the relay operates, opens the motor switch and automatically cuts out the motor from the circuit. In the second case the relay is connected outside of the controlling apparatus of the motor and affords protection for reversals of phase between the controlling apparatus and the source of power supply.

The new reverse-phase relay illustrated is made in both circuit-opening and circuit-closing styles. Both types of contacts are equipped with toggles so arranged that there is no tendency for the contacts to open or close until the toggle has buckled, the contacts being then, by means of a small spring, quickly thrown to the desired position. The type of contacts required for any installation will depend on the method of tripping out the motor switch. When contactors alone are used, circuit-opening contacts are recommended. The circuit-opening contacts are hand reset. Circuit-closing relays are used in connection with a shunt trip on air or oil circuit-breakers. Contacts of either type are of strong construction and are protected by a dustproof cover.

The relay operates on the same principle as a squirrel-cage induction motor. The operating coils correspond to the stator and a hollow aluminum cylinder, connected to the contacts, corresponds to the rotor. The cylinder (plunger) does not rotate, but moves in a straight line, either up or down, depending upon the phase rotation. When one of the phases of the line is reversed, the plunger moves and operates the circuit-opening or circuit-closing contacts.

Relays can be furnished for two-phase or three-phase service with either curent or potential windings, depending upon the amount of current and the voltage of the circuit. Current windings, which will cause the relays to operate on phase reversal at 70 per cent of normal current, are supplied for the following conditions:

For circuits up to and including 100 amperes and 550 volts, connected in series with the line; for similar circuits, connected in the secondaries of current transformers; for circuits of 600 volts and above at all currents, connected in the secondaries of current transformers.

Potential windings are supplied for circuits up to and including 550 volts, connected directly across the line; for circuits above 550 volts, connected to the secondaries of potential transformers. These coils are furnished with external resistances of the proper value for the different voltages.

Reverse-phase relays as described and illustrated herein are manufactured by the General Electric Company.

Instantaneous Circuit-Opening Reverse-Phase Relay With Hand-Reset Contacts, Top Cover Removed.

Premier Automatic Electric Vulcanizer for Repairing Automobile Tires and Household Rubber Articles.

The extraordinary development of the automobile business has stimulated the demand for a simple and effective vulcanizer by means of which repairs of pneumatic tires can be safely and properly made. Of the various types of such devices now on the market, those using gasoline or alcohol for providing

Fig. 1. Automatic Electric Vulcanizer.

the heat are a serious fire hazard in any garage and are the cause of increasing the insurance rate above that which could be secured if no open-flame devices were employed. Another disadvantage of the gasoline vulcanizer is that it is almost impossible to get exactly the right amount of heat, many tires being spoiled from excessive or insufficient heating.

The peculiar advantage of electric heat has suggested the development of an electric vulcanizer, which not only absolutely eliminates the dangers connected with other methods, but, through a simple and ingenious means, insures securing exactly the proper heat necessary to do the work, and no more. The little appliance illustrated herewith, and known as the Premier automatic electric vulcanizer, has been developed primarily for use in vulcanizing pneumatic tires, both inner tubes and outer casings. However, as will be shown further on, it also is adaptable to the vulcanizing of almost any rubber appliance.

The device is very compact, the No. 1 size being easily held in the hand. It consists of a lower plate or base on which rests as asbestos disk. Over this is placed a cover plate which is held down by two clamping thumb screws at the ends. It contains the electric heating element (made of Nichrome wire) and an automatic switch therefor. The device is built on the principle of supplying the three necessary factors which are required for effective vulcanization, which are the application of the proper temperature of heat, application thereof for a certain definite time, so as to effect the necessary cure, and application of sufficient pressure to insure making a smooth and thorough job. All these three factors are provided in this simple device. The pressure is obtained by means of the thumb nuts and the required temperature is obtained by such a design of the heating element as will produce the necessary heat without liability of scorching. This required amount of heat is assured by means of an automatic thermostatic switch, which has been properly regulated and sealed; it includes a small red button protruding from one side. In starting vulcanizing, this button is pushed in to close the switch. As soon as the proper degree and volume of heat has been developed to secure thorough vulcanization this switch is automatically opened, thus preventing spoilage.

Fig. 2. Electrically Vulcanizing An Inner Tube.

In operation for vulcanizing inner tubes of tires, the tube is placed in the manner shown in Fig. 2, current being applied by pressing the button, which later automatically opens the circuit when the work is finished; usually this takes about 20 minutes for a gradual and thorough penetration of the heat. For repairing the outer casings, the outfit is clamped against the casing without removing the latter from the wheel. For this purpose special clamping chains are provided. The operation in this case is similar, but the curved surface shown on top in Fig. 1 is used against the tire. For repairing any other object, such as a rubber glove or rubber hot-water bottle, the device is placed between the two plates as shown in Fig. 3.

This latter view shows the simplicity of using the device for various purposes of a domestic and miscellaneous character. For example, as soon as a rubber glove or ordinary hot-water bottle springs a small leak it is practically worthless; by means of this simple vulcanizer it can be easily and quickly repaired to be as good as new. This vulcanizer has been used for repairing rubber-soled tennis and gymnasium shoes and other rubber articles which have been cut or punctured. Physicians and hospitals find it a very convenient means for keeping their rubber gloves, mats and various other rubber appliances used intact and in working condition.

Fig. 3. Vulcanizing a Rubber Glove.

This device is made for various voltages, the most common being 110 volts; it can also be secured for operation on as low as six or 12 volts for connection to automobile ignition and starting batteries. The 110-volt type consumes only 0.6 ampere or about 65 watts. The outfit, complete with attachment cord and plug, simple tools for use in rubber repairing, and with rubber compound and all necessary accessories, sells complete at retail for only $3.50. It is manufactured by the Premier Electric Company, 4032-4042 Ravenswood Avenue, Chicago, Ill. The outfit is patented and guaranteed by the manufacturer.

Hughes Electric Bake Ovens.

The excellent results obtained with electric bake ovens in bakeries, restaurants, hotels and the kitchens of large institutions have attracted much attention to this type of oven and aroused interest in its construction and operation. The accompanying illustration shows the construction of such an oven, this being Hughes electric oven No. 220, which has a capacity of 120 one-pound loaves of bread or 12 standard roll pans, each 18 by 26 inches in size. This oven has three compartments.

Phantom View of Hughes Electric Bake Oven, Showing Interior Construction.

There are four heating elements, which appear in the accompanying phantom view like four layers of rows of light-colored sticks. These elements are made of heavy resistance wire wound on tubes of special composition which are held in position by angle-iron frames. These frames are mounted at the bottom of each deck and at the top of the oven. The lower side of each element which faces down into its compartment is protected by an expanded-metal netting, which is fully one inch away from the wires and makes it impossible for them to be touched. The front part of each element generates a little more heat than the back part to allow for heat loss when the doors are opened. The heat production of each element is also graduated, the bottom element generating more heat than the top one. This compensates for the gradual rise of heat to the top and gives a uniform temperature in all parts of the oven when all the switches are in one position. Each element has a separate three-heat switch.

The body of the oven rests on a substantial angle-iron frame. The body exterior is made of galvanized iron. The interior lining is made of common iron, heavily enameled on both sides for the prevention of rust. Between the exterior and interior wall, there is packed a special heat-retaining insulation three inches thick. To give both of these walls the utmost strength and rigidity without bolts or other metal connections which would conduct the heat to the outside, each one is independently braced by its own projections which reach out about two-thirds of the way through the insulating material and give ample support to their own wall—without touching the opposite wall. Moreover, these projections not only support the walls but they hold the insulation in its original and proper position. The decks are of tile, shown broken away to expose the heating elements.

All doors are hinged at the bottom and are arranged so as to close tightly; they are also well insulated to prevent heat loss. In every detail the entire oven construction provides for utilizing effectively all of the heat generated. In the vicinity of the oven the temperature is not appreciably higher than the average room temperature, in marked contrast to fuel-using ovens. This type of oven provides the most sanitary method of baking; it is free from poisonous or other objectionable gases, ash dust or other dirt, etc. The oven is easily and perfectly controlled, resulting in a superior quality of baked product that commands a larger and better patronage.

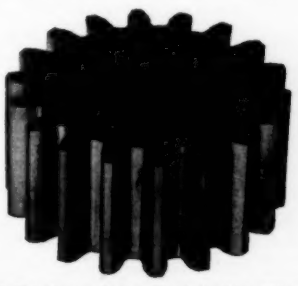
In size this particular oven has outside dimensions as follows: Height, 64 inches; length, 60 inches; width, 47 inches. Each compartment is 8 inches high, 53 inches long and 37 inches wide. The total baking surface is 41 square feet. The oven occupies only one-fourth to one-half of the floor space required for the ordinary brick oven. Moreover, it requires no space for storage of fuel, nor a large space in front for manipulation of the peel used in removing bread from the oven.

These ovens are manufactured in several sizes and capacities by the Hughes Electric Heating Company, 211-233 West Schiller Street, Chicago, Ill .

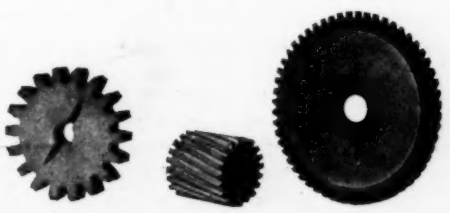
Bakelite-Micarta-D Gears and Pinions.

In the transmission of power by means of gears the impact of the teeth going into mesh produces a noise. The amount and character of the noise depends primarily upon the character of the material from which the gears are made. This noise indicates vibration, the greatest of all destructive agents, and serves to warn of losses that must be considered, as, for instance, loss of power and wear and tear on machinery caused directly by these vibrations. Noise also decreases to an appreciable extent the efficiency of the men who are compelled to work under this unpleasant and distracting influence. While the direct loss of energy due to vibration has not been given much attention until lately, it is a factor that should be considered carefully as higher and still higher speeds are employed for the transmission of power.

Steel meshing with steel at high speeds produces vibrations that result in a loud, piercing sound. Brass meshing with steel gives a less piercing sound of a lower pitch that is not so objectionable. A non-metallic material meshing with steel results in a still further reduction in vibration and consequently of noise. Non-metallic material, however, to be suitable for gears, must possess a mechanical strength sufficiently high to withstand the stresses involved without increasing the width of the face of the gear to abnormal limits. It must be hard enough to wear well and must not shrink or swell from oil or moisture, nor deteriorate in storage. The teeth, too, should be able to withstand the service requirements without metallic reinforcements of their ends, so that the two mating gears can be



Plain, Solid Spur Gear of Bakelite-Micarta-D.



Speedometer Gear, Pinion for Starting, Ignition or Lighting, and Timing Gear.

made of equal width of face to obtain uniform wear over the entire wearing surfaces of both. A non-metallic gear is quiet in operation and will outwear many classes of metal gears. In addition, a non-metallic gear is slightly elastic and will absorb shocks that otherwise would result in broken teeth or severe vibration.

A non-metallic gear material which successfully meets all of these requirements has recently been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., under the name of Bakelite-Micarta-D. This is a product of heavy duck, bonded together with Bakelite by heating while under an enormous pressure. It is as strong as cast iron, is unaffected by atmospheric changes, is verminproof, and can be stored indefinitely without shrinking or other deterioration. It can be used for gears that have to operate in oil, without any signs of swelling. In most cases neither bushings nor shrouds are required as the material is self-supporting. Where the requirements are unusually severe, however, or where the diameter of the gear is several times the width of the face, end plates may be advisable, but even in such cases the teeth need not be shrouded, and the width of the gear is determined only by the power to be transmitted.

In the non-metallic gears formerly used, in which the

Intermediate Gear of Bakelite-Micarta-D, Provided With End Plates.

teeth were shrouded, it was necessary to make the width of the face of the non-metallic material equal to the width of the face of the mating gear plus the aggregate end play of both shafts; otherwise the shrouds would mesh and the gear would be noisy. In order to fulfill this condition it was necessary to specify a greater width than would be necessary to transmit the required power. This is unnecessary with Bakelite-Micarta-D gears. In fact, it is advisable that the width of the face of these gears be made the same or less than the mating gears in order to insure uniform pressure over the entire tooth. Because of this fact Bakelite-Micarta-D gears can be utilized for many special applications where the use of any other non-metallic gear would be impracticable, as, for instance, a two-inch-face pinion meshing with a seven-inch-face flywheel.

Bakelite-Micarta-D gears readily take a good polish, machining best at high speed and with plenty of rake to the tool. This material can be machined in any direction and drills and taps readily. The same tools are used as for steel when cutting teeth, but an increase in cutting speed of 25 per cent and an increase of feed of 50 per cent may be used. A smaller pinion or larger-bore gear can be manufactured than with any other non-metallic gear material. At present this material is not made in thicknesses over two inches. Hence, when gears having a wider face are required, two or more plates of Bakelite-Micarta-D must be riveted together, using metal end plates or standard washers under the rivet heads.

Bakelite-Micarta-D material has a tensile strength, parallel to laminations, of 10,000 pounds per square inch; a compression strength of 30,000 pounds per square inch perpendicular to laminations, and of 17,000 pounds per square inch parallel to laminations; a transverse strength of 17,000; a coefficient of expansion per inch per degree centigrade, of 0.00002 inch in the direction parallel to laminations and of 0.000085 inch in the direction perpendicular to laminations. It has a specific gravity of 1.4, weighs 0.05 pound per cubic inch, and has a water absorption of 0.25 to 2 per cent by weight, depending upon the relative amount of edge surface exposed. Shrinkage and oil absorption is practically zero.

The long life of Bakelite-Micarta-D gears has been proven under the most severe service conditions and in a large variety of applications, such as timing gears for automobiles, main driving gears for punch presses, boring mills, engine lathes, pressure pumps, crane motors, textile machinery and general machine-shop service. Accurate records of these gears have shown that when properly applied and lubricated they will outlast two to four rawhide or other non-metallic materials previously used for gears, and in certain classes of service will even outlast cast iron.

Automobile timing gears can usually be made from solid plate. In case it is necessary to have a web gear, in order to allow for clearance, it is preferable to use a metal hub and web, only the teeth and rim being made of non-metallic material. Spur, bevel, and helical gears, when made from Bakelite-Micarta-D, should be used in mesh with metal gears, and in order to operate satisfactorily both gears must be cut true, lined up accurately and properly spaced between centers. The allowance for back lash should be about double the usual allowance for steel. Lubrication of Bakelite-Micarta-D gears is essential. Any good lubricating oil or grease will answer, but there should be plenty of it.

Gears made of Bakelite-Micarta-D can in general be substituted for steel, cast iron, or bronze gears, and with the same dimensions as the metal gears which they are to replace.

High-Voltage Transformers of New Thordarson Type for Experimental Laboratories.

The Electrical Engineering Laboratory of the University of Minnesota has recently installed a 300,000-volt transformer of the new Thordarson type of winding and construction that was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of November 20, 1915, and January 1, 1916. This transformer is rated at 50 kilovolt-amperes and its primary is fed from a 60-cycle, 230-volt circuit. It is inclosed in a steel tank 7 feet long, 5 feet wide and 7 feet high. The secondary terminals project three feet from the top. About 14 barrels of insulating oil is used in the tank. The entire apparatus, complete with oil, weighs a little over five tons.

One of the first tests on which the transformer was used was the testing of the 100,000-volt insulators for the transmission line being built by the Minneapolis General Electric Company from Chippewa Falls to Minneapolis. These tests were made without any reactors, resistors or other protective devices in the high-voltage circuit. Professor W. H. Springer, of the Electrical Engineering Department of the University, is greatly pleased at the excellent performance of the transformer and its extreme ruggedness. It is expected to use it for miscellaneous high-voltage testing.

The transformer was built by the Thordarson Electric Manufacturing Company, 501 South Jefferson Street, Chicago. A similar transformer has been supplied to the University of Oregon.

INDUSTRY ACTIVITIES

Betts & Betts Corporation, New York City, has issued bulletin No. 115, on automatic flashers.

Federal Sign System (Electric) announces the removal of its New York City showrooms and factory to larger quarters at 627-649 West Forty-third Street.

The Electrical Alloy Company, Morristown, N. J., will build a new plant on Ridgedale Avenue for the manufacture of electric wires and high-resistance materials.

Moran & Hastings Manufacturing Company, 16 West Washington Street, Chicago, Ill., has issued illustrated bulletin No. 15, on its line of Ohmlite lighting fixtures.

Bleadon-Dunn Company, 208 North Fifth Avenue, Chicago, Ill., manufacturer of electromedical apparatus, has issued a new price list on its Violetta high-frequency generator for violet-ray applications.

Harter Manufacturing Company, 522 South Clinton Street, Chicago, Ill., manufacturer of electric-lighting fixtures and specialties, has issued the second number of the *Nitrolite,* its house organ, which contains a description of the Chicago Municipal Pier and its lighting system.

Western Electric Company, Incorporated, New York, N. Y., has recently furnished six motor-generator sets for use on passenger steamers to supply 220-volt direct current for quartz mercury-vapor tubes for sterilizing drinking water by means of ultra-violet rays. Since most vessels have 110-volt, direct-current generators, the motor-generator sets are needed to provide the requisite potential. The installation of these water sterilizers is in accordance with a Federal law requiring purification of drinking water on interstate public carriers.

Westinghouse Lamp Company, 165 Broadway, New York City, has issued the first number of a booklet entitled "How I Did It," which has been prepared for the benefit of electrical salesmen and which contains short stories of lamp sales told among salesmen. The purpose of the publication, which will be issued monthly, is to increase the efficiency of salesmen who are interested in securing orders for lamps from home owners, store managers, factory superintendents and others. Contributions to the first issue were made by S. C. Dowling, new-business manager, Consumers Power Company, Owosso, Mich.; J. E. Bray, industrial representative, Public Service Company, Newark, N. J.; E. T. W. Alford, with W. E. Alford, contractor, Baltimore, Md., and E. W. Strauss, manager, Electric Supply & Plumbing Company, Jackson, Miss.

Electrical Exhibits at Farmers' Show.—At the annual National Implement and Vehicle Show, held at Peoria, Ill., from September 26 to October 7, there was an exceptionally large number of electrical displays, showing that the farmer is gradually being electrified. Among the exhibitors were the following: Domestic Engineering Company, Dayton, O., Delco lighting plants; the Automatic Lighting & Power Company, Lancaster, O., lighting plants; the National Electric Lighting Company, Wilton Junction, Iowa, lighting plants; Haag Brothers Company, Peoria, Ill., electric washers; Maytag Company, Newton, Iowa, washing machines; Camp Brothers & Company, Washington, Ill., washers; Hoover Suction Sweeper Company, New Berlin, O., electric sweepers; Peters Pump Company, Kewanee, Ill., motor-driven house pumps and automatic electric water system; Central Electric Company of Peoria, Peoria, Ill., Federal electric washing machine, vacuum cleaner, lighting fixtures, appliances, etc.; Illinois Traction System, Peoria, Ill., signals, maps of lines, etc.

Thordarson Electric Manufacturing Company, 501-511 South Jefferson Street, Chicago, Ill., has ready for distribution circulars on the newest types of Thordarson toy transformers. These are made in several sizes and types, which are illustrated. The value of the toy transformer in providing a source of energy for all kinds of electrical toys is clearly pointed out.

Central Electric Company, 320 South Fifth Avenue, Chicago, Ill., has issued bulletin No. 60, on its line of Maxolite fixtures for industrial lighting purposes, such as in shops, freight sheds, warehouses, terminals, factories, roundhouses, docks and yards. The fixtures illustrated are designed especially for use with Mazda type C or gas-filled lamps. The bulletin contains considerable engineering data for the solution of lighting problems.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a booklet entitled "Making Electric Service Safe." This booklet has been prepared in such a way that it is of interest not only to the general public but also to the electrical trade. General information, as well as advantages of the C-H push socket are included, and many illustrations are used to make the explanations clear. The last few pages of the booklet contain references to other C-H specialties, such as feed-through or cord switches, candle-length sockets, canopy-fixture, pendent and pull switches, and attachment plugs.

Faries Manufacturing Company, Decatur, Ill., has issued catalog No. 24. This is a 115-page book, dealing principally with the extensive line of Faries patent adjustable electric brackets, portables and metal shades. A line of electric and combination fixtures, together with fixture parts, is also covered. These Faries devices have been developed during the 36 years' experience of this well known firm, and are in very general use where high-intensity and efficient local lighting is needed. The catalog contains several hundred illustrations of portables, brackets, fixtures and parts, among them being also quite a few showing typical installations.

Electric-Furnace Regulator Featured in Westinghouse Exhibit.—A feature of the Westinghouse Electric & Manufacturing Company's exhibit at the New York Chemical Exposition which interested every technical visitor to the exposition was the Thury electric furnace regulator. This was the first time this device had been exhibited in America, although it has been installed in a number of furnaces. The function of the regulator is to keep the furnace current at a constant value for which the regulator is set. This is accomplished by automatically raising or lowering the furnace electrodes, depending on the variation in the current, by means of a motor-driven winch. The regulator controls the winch motor and causes it to run in the proper direction as the increase or decrease of the current demands. The motor does not revolve continuously until stopped by the regulator, but makes a succession of quick turns at short intervals; in this way there is no tendency for the electrodes to be pulled too far apart and thus cause unstability, since the regulator can stop the motor before it overruns. The mechanism that accomplishes these results is highly ingenious and attracted great attention. The regulator was invented by R. Thury, of Switzerland, and the Westinghouse company owns the American rights. In addition to the regulator were exhibited a squirrel-cage motor and automatic starter, ventilating fans, meters, insulation and other electrical products used in chemical industries.

LATEST APPROVED FITTINGS

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association

CABINETS AND CUTOUT BOXES, Sheet Metal.—W. F. Tanner & Company, 329 North Calvert Street, Baltimore, Md.

Label service.

Listed August 14, 1916.

CONDUIT BOXES. — Universal Electric & Specialty Manufacturing Company, 926 La Fayette Street, New Orleans, La.

Cast-iron outlet box, catalog No. 700.

Listed August 28, 1916.

FIXTURES.—Chase Electric Company, 105 South Dearborn Street, Chicago, Ill.

Continuous metal lighting strip for use with movable unit lamp receptacles assembled with attachment plugs.

Listed August 3, 1916.

FLEXIBLE TUBING FASTENER. —Edw. S. Snover Electric Company, Toledo, O.

Fastener for securing flexible tubing one-fourth inch or less, nominal diameter, in switch and outlet boxes; consisting of a formed wire having sharp turned ends to engage surface of tubing. "Snover."

Listed July 10, 1916.

OUTLET BUSHINGS AND FITTINGS.—Appleton Electric Company, 212 North Jefferson Street, Chicago, Ill.

Malleable iron galvanized, 0.5-inch, 45-degree conduit coupling.

Listed September 7, 1916.

PANELBOARDS.—W. F. Tanner & Company, 329 North Calvert Street, Baltimore, Md.

Panelboards shown by tests and examinations to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Listed August 14, 1916.

PICTURE MACHINE APPLIANCE, DOUBLE-DRIVE MOTOR.—James J. Dawson, McKeesport, Pa.

Consisting of electric motor driving two belts and pulleys through two manually operated clutches. Equipped with special motor listed beow supplied by J. J. Dawson and expressly accepted for this purpose. 1-10 horsepower, 110-220 volts, alternating or direct current. Fidelity Electric Company.

Listed August 1, 1916.

RECEPTACLES, for Attachment Plugs.—The Bryant Electric Company, Bridgeport, Conn.

Bryant or Perkins "Spartan," heater control combinations. 10 amperes, 125 volts, catalog No. 518.

Listed August 24, 1916.

RECEPTACLES, for Attachment Plugs.—The Bryant Electric Company, Bridgeport, Conn.

Bryant or Perkins "Spartan" Conduit box, 10 amperes, 250 volts, catalog No. 111. Also caps, MB, MC, MD, MG.

Listed August 29, 1916.

RECEPTACLES, Standard. — The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins." Conduit box, 660 watts, 600 volts, catalog No. 59107.

Listed August 25, 1916.

RHEOSTATS. — General Electric Company, Schenectady, N. Y.

Motor starters, Types CR-2301-06.

Listed August 19, 1916.

ROSETTES, Fuseless. — Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins" rosettes, 3 amperes, 125 volts; 1 ampere, 250 volts; cleat, catalog No. BY-25.

Listed September 1, 1916 .

SIGNAL APPLIANCES. — American Model & Instrument Company, 25 Foster Street, Worcester, Mass.

Alternating-current bells and horns for the "Amico" signal system, 75-250 volt bell, 25-60 cycles; horns, 40-60 cycles; types X, XXD and XXXD.

Listed August 15, 1916.

SOCKETS, Standard.—Harvey Hubbell, Incorporated, Bridgeport, Conn.

"Hubbell" brass-shell sockets.

Key, 250 watts. 250 volts, catalog No. 3405.

Keyless, 660 watts, 250 volts, catalog No. 3406.

Pull, 250 watts, 250 volts, catalog No. 3404.

Also above types with shadeholders attached and with "Presturn" cap and shell fastening.

Listed August 8, 1916.

SOLDERING LUGS.—H. B. Sherman Manufacturing Company, Battle Creek, Mich.

Copper lugs of drawn metal or stamped tubing for making electrical connections to wires and cables. Each lug is marked with letter "S," with its rating in amperes, under Table A of Rule 18 of National Electrical Code.

Listed August 14, 1916.

SWITCHES, Automatic.—Fess System Company, 218 Natoma Street, San Francisco, Cal.

This device is a combination motor-starting and no-voltage release switch, consisting of a double-pole, double-throw knife-switch, so arranged with springs that switch will not remain in starting position unless held manually. It is retained in running position by trigger which is released upon de-energizing of solenoid. Designed, primarily, for use in connection with rotary mechanical atomizing oil burners of this manufacturer.

Listed July 28, 1916.

SWITCHES, Surface.—The Bryant Electric Company, Bridgeport, Conn.

Ceiling switches — adaptations of standard "Bryant" or "Perkins" pull socket mechanisms. Single-pole, 1 ampere, 250 volts; 3 amperes, 125 volts.

Listed September 2, 1916.

SWITCHES, Push Flush. — The Trumbull Electric Manufacturing Company, Plainville, Conn.

"Circle T." Single-pole, catalog No. 221; three-way, catalog No. 223.

Listed August 25, 1916.

SWITCHES, Surface.—Hart Manufacturing Company, Hartford, Conn.

Heater switches, series-multiple, 30 amperes, 125 volts; 15 amperes, 250 volts; catalog Nos. 804, 8042.

Listed August 25, 1916.

WIRES, Slow-Burning. — National India Rubber Company, Bristol, R. I.

Insulation consisting of three braids. See Rule 56, National Electrical Code. Tag on coil to read: "Nat'l Elec. Code Standard." Marker: Two blue threads parallel to wire between insulation and the conductor.

Listed August 31, 1916.

WIRES, Slow-Burning Weatherproof.—National India Rubber Company, Bristol, R. I.

White slow-burning insulation on the outside. Tag on coil to read: "Nat'l Elec. Code Standard." Marker: Two blue threads between insulation and conductor.

Listed August 30, 1916.

Metal Lighting Strip for Use with Movable Unit Lamp Receptacles.—Chase Electric Company.

PERSONAL AND BIOGRAPHICAL

MR. CHARLES B. SCOTT, manager of the Bureau of Safety maintained by the Insull companies, was one of the speakers at the City Club of Chicago on Fire and Accident Prevention Day. Mr. Scott is also president of the Chicago Division of the National Safety Council. His topic was "The Personal Element in Accident Prevention."

MR. W. J. TROTT, who probably is the dean of electric-lamp salesmen, and who is a candidate for Congressman for the Fifth District of the Jovian Order, will mark the twenty-eighth anniversary of his association with the electrical industry by the convention of the Order, to be held October 18-20, at Indianapolis. The first fourteen years of Mr. Trott's electrical career were spent in the central-station business in

W. J. Trott.

several Michigan towns. In 1902 he joined the sales forces of the Fostoria Incandescent Lamp Company, and was retained when that company became connected with the National Lamp Works of the General Electric Company three years ago. Mr. Trott travels through the state of Michigan, where he is well and favorably known. His home is in Grand Rapids, where he is an influential citizen.

MR. ROBERT PRIDE has been appointed manager for the Kentucky Utilities Company, at Morganfield, Ky.

MR. C. T. FARLEY has been appointed manager of the lighting, sales and power sales department of the Kansas City (Mo.) Light & Power Company. These departments were recently combined.

MR. VERNON MANN, formerly line foreman and local superintendent at Taylor, Tex., has been appointed manager of the Tavlor district of the Texas Power & Light Company. This district includes the towns of Taylor, Thrall, Thorndale, Rockdale, Granger, Bartlett and Holland. Mr. Mann has been employed by the company since it took over the plant in Taylor, and his promotion comes as a mark of appreciation of his past work.

MR. C. H. MINOR has been transferred from the Chicago office of the Western Electric Company to New York City, where he will assume the title of sales manager.

MR. B. W. LYNCH, formerly assistant general auditor of H. M. Byllesby & Company, has been promoted to the position of general auditor of the same company. The change became effective September 28.

MR. ERNEST ALSCHULER has severed his connections with the Inter-State Electric Novelty Company as western manager, with offices in Chicago, Ill., and has accepted the position of sales manager for the American Carbon & Battery Company, East St. Louis, Ill.

MR. MORRIS L. COOKE, acting director of the Utilities Bureau, Philadelphia, made an address before the City Club of Chicago on October 10 on "The City and Its Public Utilities," in which he showed the need for the bureau and its work and made a plea for its support.

MR. ANDREW N. FOX, for many years advertising manager of the Benjamin Electric Manufacturing Company, Chicago, has retired from the electrical business to become president of the R. & F. Copper Company of Nevada, with headquarters in the Harris Trust Building, Chicago. Years ago Mr. Fox and Thomas C. Rea, who will be remembered as having taken a conspicuous part in the early electrical development of the city of Chicago, staked claims to 660 acres of copper prospect property in the Lida mining district. Mr. Rea has continued on the property, developing it each year. Quite recently Senator W. A. Clark, of Montana, secured a working option on 420 acres of this property, and established the town of Clarkdale, Nev. Mr. Fox and his associates will develop the remaining 240 acres, and have already sunk a number of shafts which are producing in promising fashion.

MR. DEAN TREAT, assistant general manager of the Wisconsin Public Service Company, Green Bay, Wis., has been appointed general manager of the La Crosse railway property of the Wisconsin Railway, Light & Power Company. He is succeeded by MR. ALBERT J. GOEDJEN, of Indianapolis, Ind. Mr. Treat went to Green Bay in 1913 as superintendent of the railway department of the Service company. He was promoted soon afterward to the office of assistant general superintendent, later to the office of assistant general manager. Previous to 1913 Mr. Treat was district superintendent of the Illinois Northern Utilities Company, at Dixon, Ill. Mr. Goedjen is a native of Manitowoc, Wis. After his graduation from the University of Wisconsin he spent several years with the General Electric Company, New York; the Commonwealth Edison Company, Chicago, and the Milwaukee Electric Railway & Light Company. Lately he was electrical engineer with the Merchants Heat & Light Company, Indianapolis, Ind.

MR. S. B. WAY, vice-president and general manager of the Milwaukee (Wis.) Light, Heat & Traction Company, which includes the Milwaukee Electric Railway & Light Company, has been responsible in a great measure for the reduction in Milwaukee residential rates for electricity, as announced on another page of this issue. The increase from 6,000 customers in 1903 to 40,000 in 1916 is a business-building accomplishment that can be mentioned with pardonable pride, and the public will appreciate the material reduction made when the latter figure was reached. Mr. Way has been connected with the Milwaukee companies since 1911 and inaugurated a continued campaign to increase the density of the customers, with results that have been particularly satisfactory to a discriminating public, to the companies,

S. B. Way.

and to Mr. Way personally. The number of customers per unit of population is higher than in most of the cities of this country. The campaign, while based fundamentally on the offering of the best possible service to the public, has been along very comprehensive lines, every legitimate avenue for the introduction of the use of electricity having been used. The new schedule of rates, besides being low, is characterized by the advantages offered for the use of electricity in small apartments and for cooking and appliances. A further reduction when the list of customers numbers 50,000 is also promised and this bespeaks the progressiveness of Mr. Way's administration.

OBITUARY.

MR. E. B. ANDREWS, SR., prominent lumberman and owner of the electric-lighting plant at Birnamwood, Wis., died recently at Stanley, Wis., aged 65 years.

MR. ALLEN A. BROWN, president of the Boston Electric Associates, controlling electric and gas companies operating on Cape Cod and Martha's Vineyard Island, died October 2 at Hotel Clifford, his Boston home, aged 81 years. He was a native of Boston and graduated from Harvard University.

CURRENT ELECTRICAL NEWS

Weekly Record of Construction Activities

EASTERN STATES.

CLINTON, MASS.—The sale of power from the state's hydroelectric plant at the Wachusett reservoir will be continued to the New England Power Company, pending a readjustment on completion of a transmission line between the plant and another state undertaking at the dam of the Southboro reservoir in Fayville.

GREAT BARRINGTON, MASS.—The F. T. Ley Company, of Springfield, has been awarded the contract for the construction work for the Great Barrington Electric Light Company, which is to extend its transmission lines to Southfield and New Marlboro.

LYNN, MASS.—The Water Commissioner has been authorized by the City Council to contract with the Lynn Gas & Electric Company for electric power for all pumping stations in the city, and a transmission line will be built to a new station on Ipswich River, the city to pay for labor and materials. The rate for pumping will be two cents per kilowatt-hour for 15,000 kilowatt-hours a month, 1.75 cents for 15,000 to 20,000 kilowatt-hours, and 1.5 cents for amounts in excess, no power being used between 4 and 9 p. m. The contract runs for five years.

NEWBURYPORT, MASS. — The Newburyport Gas & Electric Company has been granted locations for 65 poles in this city.

NORTHAMPTON, MASS. — Armour & Company have opened a new branch house at Northampton, in which an electric refrigerating system has been installed by the Hartford Automatic Refrigerator Company. A 10-horsepower three-phase motor operates the system. Both electric light and power service are used.

SAUGUS, MASS.—The Selectmen are considering a new contract with the Lynn Gas & Electric Company for street lighting, by which an all-night schedule will be observed. The current rate was $16 per incandescent lamp, on a moonlight schedule, and $67 per arc lamp. The new contract calls for a yearly appropriation of about $500 more.

HORNELL, N. Y.—The Hornell Electric Company plans the erection of transmission lines to Arkport and Canaseraga and will furnish energy for power and lighting in those villages, according to an announcement made by L. T. Mason, superintendent of the company. Additional extensions are also planned.

LANCASTER, N. Y.—The Depew & Lancaster Light, Power & Conduit Company has petitioned the Public Service Commission for permission to construct electric transmission lines in the towns of Clarence and East Hamburg.

POTSDAM, N. Y.—The St. Lawrence Transmission Company of Potsdam has completed a new 22,000-volt transmission line to Rensselaer Falls. The line extends west from Dekalb Junction, where a substation is located, and the energy is delivered to the Rensselaer Falls Light & Power Company for distribution.

BAYONNE, N. J.—The Board of City Commissioners has approved a petition providing for the installation of a new street-lighting system along lower Broadway, to form a white way. In accordance with agreement with the Public Service Electric Company, an underground conduit system will be installed by the company along the thoroughfare.

MAYS LANDING, N. J.—The Bethlehem Steel Company has purchased a large tract of land along Egg Harbor River, to be used for a proving ground for ammunition, guns, etc. A large testing station, equipped with electric measuring devices for all phases of work, will be erected.

NEWARK, N. J.—The German Hospital has approved final plans for its proposed power house on Bank Street. Guilbert & Bettelle, 671 Broad Street, are the architects.

NUTLEY, N. J.—The Board of Commissioners is negotiating with the Essex County Park Commission for the installation of new and improved street lamps in Yantacaw Park.

TRENTON, N. J.—The New Jersey Gas & Electric Company has increased its capital from $500,000 to $700,000 to provide for extensions.

CHAMBERSBURG, PA.—The Cumberland Valley Utilities Company is the name of a new company which will take over and own and operate the Chambersburg, Green Castle and Waynesboro trolley line, the Chambersburg and Shippensburg trolley line, the Waynesboro gas plant, the Waynesboro electric-lighting plant, the Green Castle electric-lighting, Shippensburg gas and electric-lighting companies. A syndicate formed in New York City of capitalists from that city and Baltimore has closed options on the properties named. The new company takes charge on November 1. R. D. Sefton, manager of the Waynesboro trolley line, will likely manage the joint electric railway. The headquarters of the new company will be in Chambersburg and a large sum of money will be spent improving the various utilities.

OIL CITY, PA.—The City Council has signed a new five-year contract with the Citizens Light & Traction Company for street lighting. The contract provides for the replacement of the 250-candlepower arc lamps with 400-candlepower nitrogen-filled lamps and the 60-candlepower tungsten lamps with 100-candlepower nitrogen-filled lamps.

BALTIMORE, MD.—The Southern Hotel Company, which is building a hotel at Light and German Streets, has requested bids on a complete electrical equipment, consisting of generators, switchboard and auxiliary apparatus.

WILLIAMSPORT, MD.—W. D. Byron & Sons, of this city, recently closed a contract with the Westinghouse Electric & Manufacturing Company for a 75 and a 175-kilovolt-ampere engine-type generator, a three-panel switchboard and auxiliary apparatus. Twenty-five alternating-current motors, ranging in size from one to 30 horsepower, were also purchased. The company is changing over its entire plant from direct to alternating current.

WASHINGTON, D. C.—Frederick J. Rice, president of the Columbia Heights Citizens' Association, has filed a petition with the Public Utilities Association asking for an extension of the underground system of the Washington Railway & Electric Company in Georgia Avenue between Florida Avenue and the Brightwood car barn.

MADISON, N. C.—Plans are being discussed for an installation of an electric-lighting system estimated to cost $8,000. E. L. Morton is interested in the project.

PILOT MOUNTAIN, N. C.—The Pilot Mountain Electric Company has been granted a 20-year franchise to construct and operate an electric-lighting system. C. E. Hiatt is interested in the company.

CHARLESTON, S. C.—The City Council is considering the granting of a franchise to J. P. Wood, of Augusta, for furnishing electrical energy for light and power here. The franchise asked for by Mr. Wood, who represents the J. P. Wood Light & Power Company, contemplates the purchase of energy from the hydroelectric company which supplies the city of Augusta and transmitting it over high-tension lines to Charleston and intermediate points. It is also planned to erect an auxiliary steam power plant here to be available for emergency uses.

MACON, GA.—Alderman Fred Williams, City Engineer Humphreys and others recently made a trip to Jacksonville, where they inspected the municipal lighting plant in that city with a view to gathering data to lay before the City Council, which is now considering the erection of a municipal plant.

TITUSVILLE, FLA. — The Southern Utilities Company, of Jacksonville, has purchased the electric-lighting plant of the Titusville Electric Light Company for $35,000. The former company owns the Titusville ice plant and intends installing new machinery and otherwise improving it and the electric-lighting plant at a cost of approximately $15,000.

NORTH CENTRAL STATES.

CINCINNATI, O.—Extensions to the proposed ornamental street-lighting system which has been laid out in the business section have been decided upon by the lighting committee of the City Council on the request of business men in the sections omitted from the district to be covered.

DUNKIRK, O.—A 10-year franchise to furnish energy for the local street-lighting system has been awarded to the Hardin-Wyandot Lighting Company, of Kenton.

YOUNGSTOWN, O.—A 25-year franchise has been granted by the City Council to the Mahoning County Light Company, covering the city of Youngstown, with a six-cent rate and a minimum charge of 50 cents provided for. It is understood that the franchise makes probable the construction of a power plant by the company to meet the city demand. A tentative plan for a city plant is rendered improbable by this move.

BICKNELL, IND.—The Indiana Water & Power Company, of Chicago, has purchased the holdings of the Bicknell Light & Power Company. The electric-lighting plant here will be dismantled and the machinery taken to Edwardport, five miles east of this city, and a larger plant will be constructed here. The new company will provide energy for light and power in several surrounding towns and is asking for franchises at Edwardport, Westphalia, Sandborn, Marco, Lyons, Switz City and Bloomfield. A plant will be constructed in the latter city and transmission lines will connect Elnora, Odon and Newberry. The company will also assume the ownership of the Lynn coal mine, formerly the property of the Bicknell company, which will be operated to provide coal for four power stations that the company expects to have in operation within a short time.

SHOALS, IND.—The Shoals Light & Power Company has been incorporated with a capital of $10,000 to furnish energy for light and power in this city. The incorporators are G. A. Harrop, B. C. Johnson and L. D. Hincher.

GERMANTOWN, ILL.—The Germantown Electric Light Company has been incorporated with a capital of $10,000 by Harry Schurmann and others to furnish electric service here.

GILLESPIE, ILL.—The Southern Illinois Light & Power Company, which owns the electric-lighting plant at Greenville, Ill., is installing a transmission line from Litchfield, Ill., at an estimated cost of $25,000. The company has purchased additional property here and is planning to erect a new building and install machinery at a cost of $25,000. Energy will be furnished from this plant to Litchfield by means of the new transmission line.

MARION, ILL.—W. H. Schott, of the banking firm of Kennedy, Mitchell & Company of New York City, recently made a tour of inspection preparatory to starting the construction work on the St. Louis & Southern Illinois electric railway connecting Marion, Harrisburg, Herrin, Benton, West Frankfort and Johnson City. The estimated cost of the project is $3,000,000.

PEORIA, ILL.—John H. Merkle, president of the Association of Commerce, has secured the approval of Mayor Woodruff for improved street lighting. The plan is to place ornamental standards and cluster lights in Fulton, Bridge, and Chestnut Streets.

NORTHVILLE, MICH. — Voters here have approved the sale of the municipal electric-lighting plant to the Detroit Edison Company for $26,000. The company plans to erect an office here and make this city its headquarters for the local district outside of Detroit as far east as Romeo.

VASSAR, MICH.—At a special election here bonds in the sum of $25,000 were

voted for improvements to the electric-lighting and water plants.

DE PERE, WIS.—Additional generating equipment has been installed in the plant of the De Pere Electric Light & Power Company.

WILTON, WIS.—Plans are being made by George Manske, manager of the Wilton Light & Power Company, for the installation of additional hydroelectric generating equipment.

GARY, MINN.—A franchise has been granted to J. F. Heiberg for the construction and operation of an electric distribution system for light and power in this city.

GOODRIDGE, MINN.—Plans are being made here for the establishment of an electric-lighting plant.

LAKE PARK, MINN.—Bids are being received for the erection of an electric-lighting plant for the Sand Beach Sanatorium, Lake Park, by the State Board of Control, St. Paul, Minn.

MAZEPPA, MINN.—Bonds in the sum of $8,000 have been voted for the construction of an electric-lighting system here.

NICOLLET, MINN.—Ways and means are being considered here for securing electric-lighting service. Anton Scheuller and others have petitioned the Consumers Power Company to extend its lines to this city.

REDWOOD FALLS, MINN.—The Northern States Power Company has purchased the property of the Wherland Electric Company, which operates in the vicinity of Redwood Falls and supplies energy to the towns of North Redwood, Morton, Morgan, Franklin, Gilfillan and other towns in that locality. It is understood the consideration was $60,000. The Northern States Power Company is extending its transmission lines west from Minseapolis and will supply these towns and a number of other towns in central Minnesota from its main transmission lines.

CEDAR RAPIDS, IOWA.—The Iowa Electrical Company, of which John A. Reed is president, has increased its capital stock from $600,000 to $800,000. The company is making a number of extensions to its transmission lines.

SHENANDOAH, IOWA.—At an election to be held November 7 the proposition of erecting a municipal heat, light and power plant will be voted on.

WEST CHESTER, IOWA.—Bonds have been voted for the erection of an electric-lighting plant here.

JEFFERSON CITY, MO.—The Ozark Power & Water Company has filed an application with the Public Service Commission for authority to purchase the municipal electric-lighting plant at Pierce City, the consideration being $6,000.

MOBERLY, MO.—The City Council is planning the installation of additional street-lighting units.

ALMA, KANS.—The City Council has granted a new 20-year franchise to the Alma Light Company, the city retaining the right to purchase the plant after five years. The company has prepared plans to rebuild its distribution lines and make other improvements, the total cost of which will be about $7,500.

WICHITA, KANS.—The Kansas Gas & Electric Company, of this city, has asked approval of a bond issue for $122,000, part of the proceeds to be used for improvements in Wichita, Newton, El Dorado, Pittsburg, Independence, Cherryvale and Arkansas City.

WOONSOCKET, S. D.—Bids are being received by the City Council for furnishing and erecting a fire pump with a capacity of 500 gallons per minute, and direct-connected to a 30-horsepower 60-cycle three-phase 2,300-volt motor. Specifications may be secured from Sullivan & Putnam, engineers, Huron, S. D.

GARRISON, N. D.—The Garrison Coal, Light & Power Company has been incorporated with a capital of $25,000 and will furnish electric service in this city.

SOUTH CENTRAL STATES.

FRANKLIN, KY.—The West States Utilities Company, of Louisville, has purchased the holdings of the Franklin Electric & Ice Company.

GEORGETOWN, KY.—On November 7 the city will vote on a proposed $100,000 bond issue to provide for electric-lighting and water systems. Mayor Kinzea Stone may be addressed.

GREENVILLE, KY. — The Kentucky Public Service Company has purchased a light and water franchise from the city and it is announced that the company previously had purchased the majority of the stock of the Greenville Light & Water Company, the franchise of which has 12 years to run, and will take it over. The Public Service company has also purchased and taken charge of the Central City Light & Power Company, of Central City, Ky.

LANCASTER, KY.—Bostin Brothers, of this city, have purchased the 20-year electric-lighting franchise offered by the city. A 24-hour service will be maintained.

MIDDLESBORO, KY.—Fire destroyed the powerhouse of the Monarch Coal Company here on October 6, causing a loss of several thousand dollars.

HUNTSVILLE, ALA. — The Alabama Power Company is preparing to make extensive additions of its power plant here and will install a 1,000-horsepower turbine soon.

DE WITT, ARK.—The Stuttgart Public Service Company, of which J. G. Rossman is president, has been granted a 50-year water and electric-lighting franchise by the City Council. The company is preparing plans for the erection and installation of a plant here.

WELCH, LA.—An election will be held to consider the question of issuing $15,000 in bonds for improvements to the local electric-lighting plant.

ARDMORE, OKLA.—Plans are maturing here for the construction of an electric railway from Ardmore to the new oil field at Fox. The Ardmore Railway Company and local oil men are behind the project. The statement was made that surveyors would be placed in the field at once. The company ultimately plans to develop water power on the Washita River, north of here.

SKIATOOK, OKLA.—The city contemplates the installation of electric-lighting and waterworks systems.

BEAUMONT, TEX. — The Beaumont Traction Company has amended its charter, increasing its capital stock from $600,000 to $1,000,000. It will make improvements to its street railway system. The company is owned by the Stone & Webster Engineering Corporation, of Boston, Mass.

BEAUMONT, TEX.—The Southwestern Telegraph & Telephone Company, which recently purchased the 173-mile toll line of the Texas Long Distance Telephone Company in Eastern Texas, including the exchanges at Koontze, Woodville and Cushing, plans to rebuild the entire system. Between 5,000 and 7,000 new poles will be erected for the long-distance line.

DALLAS, TEX.—The Dallas Union Terminal Company has installed its own electric light and power plant for its station and terminals which have just been finished at a cost of $5,000,000.

GALVESTON, TEX. — The Galveston Grade Raising Association has under consideration plans for raising the grade of the city several feet in order to place it above possible overflow from the waters of the gulf in time of storm. The improvement will cost several million dollars and will involve the rebuilding of the street railway lines and the raising of several hundred buildings to the new grade level.

MIDLOTHIAN, TEX.—The Texas Power & Light Company has commenced the operation of the local electric-lighting plant. The plant will be operated until a transmission line now being built to this city is completed.

PORT ARTHUR, TEX.—The Stone & Webster Engineering Corporation, of Boston, Mass., which owns the interurban electrie railway that runs between Port Arthur and Beaumont, plans to erect a new brick station and make other improvements here.

ROCKDALE, TEX.—The Texas Power & Light Company is now furnishing electric light and power to this city by means of a transmission line from Waco and Taylor. The local plant was taken over on October 1.

STAMFORD, TEX.—The Stamford Gas & Electric Company will extend the street-lighting system here.

WACO, TEX.—The installation of additional boilers in the East Waco power plant of the Texas Power & Light Company has been completed and this station now has a capacity of 20,000 horsepower.

WICHITA FALLS, TEX.—Due to increasing business, the Wichita Falls Electric Company is installing an additional 500-horsepower boiler. A new 1,000-kilowatt turbine was recently put in operation.

DATES AHEAD.

New Mexico Electrical Association. Executive meeting, El Paso del Norte Hotel, El Paso, Tex., October 15-17. Secretary pro tem, E. A. Thiele, 112 West Third Street, Roswell, N. M.

New England Section, N. E. L. A. Annual convention, Pittsfield, Mass., October 17-20. Secretary, O. A. Bursiel, 149 Trenton Street, Boston, Mass.

Jovian Order. Annual convention, Indianapolis, Ind., October 18-20. Secretary, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

American Physical Society. Nela Research Laboratory, Cleveland, O., October 27-28. Secretary, A. D. Cole, Ohio State University, Columbus, O.

Telephone Pioneers of America. Annual meeting, Atlanta, Ga., October 27-28. Secretary, R. H. Starrett, 195 Broadway, New York City.

Electric Power Club. Hot Springs, Va., November 15-18. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

Ohio Society of Mechanical, Electrical and Steam Engineers. Annual meeting, Columbus, O., November 16. Secretary, F. E. Sanborn, Ohio State University, Columbus, O.

Association of Railway Electrical Engineers. Annual convention, Hotel La Salle, Chicago, Ill., October 31 to November 3. Secretary, A. J. Andreucetti, Chicago & Northwestern Railway Company, Chicago, Ill.

Kansas Public Service Association. Annual meeting, Topeka, Kans., December 7-8. Secretary, E. A. Wright, Manhattan, Kans.

WESTERN STATES.

POPLAR, MONT.—On October 20 the question of issuing $6,500 in bonds to purchase or construct an electric-lighting plant will be submitted to vote.

ROUNDUP, MONT.—Bids are being received for the installation of street lamps in special lighting improvement district No. 15. C. A. Renshaw is city engineer.

PHOENIX, ARIZ.—The Walapai Lighting & Powe. Company has been incorporated with a capital stock of $50,000 by Robert Roe, Arthur Fay, A. L. Cox and others.

PRESCOTT, ARIZ.—The Arizona Hydraulic Power Company is the name of a new company organized by Edward Meek and associates, who will furnish the capital for the development of hydroelectric power here. The plan is to construct a diversion dam at a point 23 miles below Camp Verde.

SALT LAKE CITY, UTAH.—A contract has been signed with the Utah Power & Light Company for the extension of its transmission line to the Fissues Exploration Company and to the mill being constructed by the company in American Fork Canon.

YERINGTON, NEV. — The Yerington Electric Company has applied for a 50-year franchise in this city.

BOISE, IDAHO.—Sealed bids are being received by the City Council for the construction and installation complete, including cables, cutouts, lamp posts with concrete bases, globes and 250-candlepower, nitrogen-filled Mazda lamps in local lighting district No. 2. Plans and specifications are on file in the city engineer's office.

POCATELLO, IDAHO.—Property owners on the east side of town have asked the City Council to take some action in regard to street lighting and plans are under way for improvements to the system.

HOQUIAM, WASH.—Hoquiam voters on November 7 will pass on a bond issue of $175,000 for the purchase of the electric power distributing plant in Hoquiam. The bond project is the outgrowth of the proposal submitted to the city several weeks ago to sell the city electrical energy at a city switchboard. At present energy for lighting the greater part of the city streets is furnished by the Grays Harbor Railway & Light Company.

SEATTLE, WASH.—The construction of a new power plant above Marblemount on the Skagit River is indicated by the filing of three water power rights by G. M. Tait, of Seattle, permitting him to divert 15,000 cubic feet of water per second. Electricity will be furnished to railways, factories, etc.

SPOKANE, WASH.—The adoption of new specifications for the city's street-lighting system and the advertisement for bids for its installation are asked by Manager E. Darrow of the Spokane Heat, Light & Power Company.

EUGENE, ORE.—The estimated cost of the extension of the city light and power wires to Santa Clara and the extension out of that village as proposed is about $6,000, according to figures submitted by G. W. Geller, superintendent of public utilities.

MARSHFIELD, ORE.—A. L. Martin, manager of the Coos Bay division of the Oregon Power Company, has announced that the company is about to make improvements and extensions to its service which will represent an expenditure of about $90,000.

LOS ANGELES, CAL.—Property owners on Washington Street have petitioned the City Council for the installation of ornamental lights.

LOS ANGELES, CAL.—The Southern California Edison Company has awarded the contract for the erection of a substation on Huntington Drive in Lamanda Park.

MANHATTAN, CAL.—The City Trustees have adopted a resolution calling for the installation of lighting posts and appliances on portions of Twelfth and Thirteenth Streets and certain alleys adjacent thereto.

MERCED, CAL.—Engineer C. T. Phillips, of San Francisco, has been engaged by the city to prepare plans and specifications for the proposed electrolier system for Merced's business district.

RIVERSIDE, CAL.—Mayor Ford and Superintendent Cutting have been appointed a committee to act in the matter of awarding a contract for the construction of ornamental lighting posts to be erected on Highland Place.

SACRAMENTO, CAL. — Residents of North Sacramento have voted for the establishment of a public lighting district. Lights will be installed shortly by the Great Western Power Company.

SAN FRANCISCO, CAL.—The Railroad Commission a few days ago issued 58 orders to electric and telephone corporations, granting authority for extensions of time within which these public utilities may comply with the law referring to the placing, erection, use and maintenance of electric poles, wires, cables and appliances. The orders direct the companies to proceed with the work as rapidly as possible.

SAN FRANCISCO, CAL. — The Sierra Electric Power Company has been denied a certificate of public necessity and convenience by the California Railroad Commission to distribute and sell electricity in certain parts of Butte, Colusa, Glenn, Shasta and Tehama Counties, on the ground that the territory in question is now being served well at reasonable rates by the Northern California Power Company and the Pacific Gas & Electric Company.

STOCKTON, CAL.—The Board of Supervisors will hear protests on October 20 on the proposed formation of a public highway lighting district in Tuxedo Park.

Proposals

MOTOR-DRIVEN PUMP.—Bids will be received until October 23 by R. E. Alexander, City Purchasing Agent, Minneapolis, Minn., for one 30,000,000-gallon electric-motor-driven centrifugal pump.

TELEGRAPH POLES.—Sealed proposals will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until October 25, for furnishing steel telegraph poles, and crossarms for iron poles complete with bolts. (Refer to Proposal No. 856.)

WIRE.—Sealed proposals will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until October 26, for furnishing 1,000 miles of wire. Specifications may be obtained on application to the above named office. (Refer to Proposal No. 857.)

SIGNAL CORPS SUPPLIES. — Sealed proposals will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until October 24, for furnishing phosphor-bronze wire, rubber-covered copper wire, wire fixture, cable, etc. (Refer to Proposal No. 865.)

STREET-LIGHTING FIXTURES.—Bids will be received by the West Chicago Park Commissioners, Union Park, Chicago, Ill., until October 24 for 230 series street-lighting fixtures of the inner binding post type, in accordance with the specifications on file in the office of the Commissioners.

STEEL TOWERS.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until October 28, for constructing two 300-foot steel towers at the Navy Yard, Philadelphia, Pa. Plans and specifications may be obtained on application to the Bureau of Yards and Docks, or to the Commandant, Navy Yard, Philadelphia, Pa.

FIRE-ALARM CABLE.—Sealed proposals will be received by the Commissioner of Gas and Electricity, 614 City Hall, Chicago, Ill., until October 20, for furnishing fire-alarm cable in the following approximate amounts: No. 19 B & S. gauge paper-insulated, lead-covered cable, 5,280 feet of 5-pair cable, 5,280 feet of 10-pair cable, and 5,280 feet of 15-pair cable. Proposals must be made out upon blanks furnished by the said commissioner. W. G. Keith, Commissioner of Gas and Electricity.

ELECTRICAL WORK.—Sealed bids will be received by the Postoffice Department, Washington, D. C., until October 25, for furnishing and installation of the mechanical equipment of and including the plumbing, heating apparatus, electric conduits and wiring, interior lighting fixtures, fire-alarm system and the elevator cars and machinery for the United States Postoffice Department equipment shops to be located at Fifth and W Streets, N. E., Washington, D. C. Plans and specifications will be furnished upon application to the Chief Clerk, Postoffice Department, Washington, D. C. J. C. Koons, Acting Postmaster-General.

ELECTRICAL SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., for furnishing supplies at the following naval stations: Schedule 221, Washington, D. C., 6,600 feet of single-conductor cable. Schedule 225, Washington, D. C., one 135-ton overhead traveling crane. Schedule 246, Brooklyn, N. Y., two electrically driven deck winches. Schedule 256, Philadelphia, Pa., one electric spot welder. Bidders desiring to submit proposals should make application immediately for schedules to the Bureau, or to the purchasing office nearest to navy yard where delivery is to be made.

New Incorporations

CLEVELAND, O.—The Mead Electric Signal Company has increased its capital stock from $50,000 to $100,000.

TOLEDO, O.—The Electric Converter Company. Capital, $50,000. Incorporators: M. L. Groves, S. R. Groves, M. G. Delaney, A. S. Hickok and W. C. Groh.

NEW YORK, N. Y.—The Automatic Electric Generating System Corporation. Capital, $100,000. Incorporators: M. Elson, M. Giles and F. Samuels, 149 Broadway.

WILMINGTON, DEL.—Union Electric Steel Company. Capital, $350,000. Incorporators: Herbert E. Latter and Norman P. Coffin, Wilmington, and Clement M. Egner, Elkton, Md.

BRONX, N. Y.—Irving A. Bogan, Inc. Capital, $5,000. Electrical contracting. Incorporators: Irving A. Bogan, 259 East 182nd Street; Jacob Levy and George T. Ehler, New York City.

DOVER, DEL.—The Coleman Leasing Corporation. Capital, $1,000,000. Manufacture, sell, lease and operate illuminating signboards. Incorporators: L. H. Gunther, S. B. Howard and S. Anderson, all of New York City.

NEW YORK, N. Y.—American Foreign Power & Light Corporation. Capital no par value; begin with $500. Deal in bonds, stocks, securities, for light, heat and power outside the state. Incorporators: W. J. Stewart, W. G. Wiechmann and E. H. Green, 41 West 83rd Street.

Financial Notes

The Massachusetts Lighting Company is offering to preferred shareholders right to subscribe at par to new issue of $494,000 preferred stock in ratio of one new share for each ten now owned.

The Wisconsin State Public Service Commission in Jefferson City granted permission, September 30, to Union Electric Light & Power Company to issue $921,000 worth of gold bonds. They are to be 25-year, maturing May 1, 1933, $1,000 each, bearing five-per-cent interest.

The gross revenues of the Pennsylvania Water & Power Company, which supplies Baltimore with electric power generated at Holtwood, Pa., are now running at the rate of approximately $1,250,000 annually, which is a substantial increase over 1915. The company will close one of the most prosperous years in its history on December 31 of this year. At the last meeting of the board of directors the dividend was increased from 4 to 5 per cent. The management is now making extensive improvements at its dam at Holtwood which will increase the capacity of the hydroelectric plant without adding to operating expenses.

Following authorization by the California State Railroad Commission of the telephone company consolidation in Santa Barbara County, it was said that consolidation of the Home and the Bell (Pacific States) companies would be effected within 60 days. The proposed consolidation would affect 60,000 Home and 65,000 Pacific stations in Los Angeles. The Home system is to be acquired by the issuance of $8,427,000 in bonds. The Pacific company is to receive $1,500,000 in bonds of the Southern company for its holdings. According to those behind the plan the $9,927,000 in bonds which will be issued will be covered by the property, with a claimed valuation of $15,255,000, without franchise rights.

Dividends.

	Term	Rate	Payable
Am. Lt. & Trac., com.	Q	2.5 %	Nov. 1
Am. Lt. & Trac., com.	Stk	2.5 %	Nov. 1
Am. Lt. & Trac., pf.	Q	1.5 %	Nov. 1
Bklyn. City R. R.	Q	2 %	Oct. 16
Colo. Pw., pf.	Q	1.75%	Dec. 15
Colo. Pw., com.	S	1 %	Oct. 16
Com. Edison	Q	2 %	Nov. 1
Com. Pw., Ry. & St., pf.	Q	1.5 %	Nov. 1
Com. Pw., Ry. & Lt.	Q	1 %	Nov. 1
Edison Co., Boston	Q	$3	Nov. 1
Elec. Utils., pf.	Q	1.25%	Oct. 15
Houghton Co. Elec. Lt., pf.	S	3 %	Nov. 1
Houghton Co. Elec. Lt., com.	S	2.5 %	Nov. 1
Ill. No. Utils., pf.	Q	1.5 %	Nov. 1
Monon Val. Trac., com.	Q	1 %	Oct. 14
Minnes. & Ont. Pw., pf.	Q	1.5 %	Oct. 10
Montreal Lt., Ht. & Pw.	Q	2 %	Nov. 15
Ottumwa Ry. & Lt., pf.	Q	1.75%	Oct. 16
Pac. Gas & Elec.	Q	1.25%	Oct. 16
Puget Sd. Trac., Lt. & Pw.	Q	75c	Oct. 16
Westing. A. B.	Ex	$5	Nov. 21
West. Sts. Gas & Elec., pf.	Q	1.75%	Oct. 15

Reports of Earnings.

NORTHERN STATES POWER.

	1916	1915
August gross	$ 443,982	$ 377,343
Net after taxes	228,098	197,738
Twelve months' gross	5,744,706	4,868,762
Net after taxes	3,201,097	2,694,728

UNITED LIGHT & RAILWAYS COMPANY.

	1916	1915
Twelve months gross	$1,850,434	$1,522,865
Net after taxes	1,709,533	1,404,755
Surplus after charges	1,144,528	905,081

CALIFORNIA RAILWAY & POWER.

The California Railway & Power Company has issued its pamphlet report for the

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH PREVIOUS WEEK.

	Oct. 9	Oct. 2
American Telephone & Telegraph (New York)	133	133½
Commonwealth Edison (Chicago)	145½	145½
Edison Electric Illuminating (Boston)	238	235
Electric Storage Battery, common (Philadelphia)	71	71¼
Electric Storage Battery, preferred (Philadelphia)	71	71¼
General Electric (New York)	180¼	181½
Kings County Electric (New York)	130	130
Massachusetts Electric, common (Boston)	5	5¾
Massachusetts Electric, preferred stamped (Boston)	34	35¼
National Carbon, common (Chicago)	220	215
National Carbon, preferred (Chicago)	123½	----
New England Telephone (Boston)	126	127¼
Philadelphia Electric (Philadelphia)	28	28¼
Postal Telegraph-Cables, common (New York)	85	85
Postal Telegraph-Cables, preferred (New York)	66¾	66½
Western Union (New York)	100½	100½
Westinghouse, common (New York)	64¾	64½
Westinghouse, preferred (New York)	70	72

year ended June 30, 1916. The income account compares as follows:

	1916	1915
Interest on notes receivable, etc.	$153,327	$141,268
Commission	50,000	.....
Salaries, taxes, fees, interest, etc.	36,947	14,071
Net for year	166,380	127,197
Surplus previous year	43,633	115,936
Dividends on prior preferred stock	196,000	199,500
Profit and loss surplus	14,014	43,633

ALLIS-CHALMERS.

Reports of Allis-Chalmers Manufacturing Company for second quarter and first two months of third quarter of 1916 follow:

	Sales Billed	Net Profit
April	$1,434,779	$291,486
May	1,733,015	327,912
June	1,938,336	331,363
July	1,291,694	163,567
August	1,311,903	142,405

Unfilled orders on hand August 31 amounted to $11,639,750. Falling off of net earnings during July and August was due to machinist strike which started July 18 and was declared off September 26.

GEORGIA RAILWAY & POWER.

	1916	1915
August gross	$ 570,226	$ 498,869
Net after taxes	256,904	203,808
Eight months gross	4,548,368	4,170,522
Net after taxes	2,003,140	1,720,184

REPUBLIC RAILWAY & LIGHT.

	1916	1915
August gross	$ 395,579	$ 260,792
Net after taxes	152,431	102,504
Total income	154,808	102,647
Surplus after charges	82,371	45,725
Eight months' gross	2,596,205	1,968,619
Net after taxes	1,072,753	750,037
Total income	1,075,999	751,109
Surplus after charges	521,168	304,263
Balance after preferred dividends	312,948	96,607

WISCONSIN EDISON COMPANY, INC.
(North American Subsidiary)

	1916	Per cent Gain Over 1915
August gross	$ 830,203	17.78
Expenses and taxes	529,857	18.66
Net	300,346	16.26
Balance available for depreciation and for Wisconsin Edison, Inc.	164,937	36.21
Twelve months' gross	9,707,962	14.84
Expenses and taxes	5,736,057	13.89
Net	3,971,905	16.26
Balance available for depreciation and for Wisconsin Edison, Inc.	2,357,212	32.32

The appropriation for depreciation of subsidiary properties for the year ended August 31, 1916, was $1,031,496, an increase of 15.85 per cent over the preceding year. After deducting interest, taxes and other expenses of Wisconsin Edison, Inc., the balance for the twelve months ended August 31, 1916, was equivalent to $4.31 a share on its stock, compared with $2.53 a share for the twelve months ended August 31, 1915.

BOSTON MASSACHUSETTS ELECTRIC COMPANY.

Boston Massachusetts Electric Company reports to the Public Service Commission for the year ended June 30, 1916, as follows:

	1916	1915
Gross	$ 163,754	$ 595,449
Net	149,155	570,258
Deficit after charges	844	*396,865
Dividends paid	.....	484,128
Deficit	844	87,262
Surplus, June 30	2,585,339	2,684,184

*Surplus.

PHILADELPHIA COMPANY.

All departments of the Philadelphia Company reported combined earnings for August and the five months ended August 31, as follows:

	1916	1915
August gross	$2,208,321	$1,912,204
Net after taxes	791,845	765,536
Five months' gross	11,635,545	9,987,158
Net after taxes	4,886,743	4,212,618
Light and Power Department:		
August gross	$ 524,049	$ 409,782
Net after taxes	204,341	191,195
Five months' gross	2,627,503	2,094,148
Net after taxes	1,163,286	996,663

EL PASO ELECTRIC COMPANY.

	1916	1915
August gross	$ 84,157	$ 75,111
Net after taxes	6,035	32,431
Surplus after charges	1,116	28,228
12 months' gross	1,054,363	979,878
Net after taxes	451,137	452,269
Surplus after charges	396,253	401,908

INTERMOUNTAIN RAILWAY LIGHT & POWER.

	1916	1915
Twelve months gross, August 31	$ 208,232	$ 153,230
Net after taxes	82,967	56,734
Surplus after charges	53,217	34,167

New Publications

DATA ON ELECTRIC-RAILWAY-TRACK LEAKAGE.—A report on this subject (technologic paper No. 75) has been issued by the Bureau of Standards, Washington, D. C. This report is a part of the general investigation of electrolysis carried on by the Bureau. Its object is to show the leakage of electric current which may occur from street-railway tracks under operating conditions. The report emphasizes the importance of maintaining as high resistance to ground as is feasible, but especially of having a high standard of rail bonding and cross bonding on all lines. A copy of the report may be obtained free by those interested addressing the Bureau.

INFLUENCE OF FREQUENCY ON ELECTROLYTIC CORROSION.—The Bureau of Standards, Washington, D. C., has issued technologic paper No. 72, entitled "Influence of Frequency of Alternating or Infrequently Reversed Current on Electrolytic Corrosion." The importance of the results given in this paper lies in the fact that there are large areas in practically every city in which the polarity of the underground pipes reverses with periods ranging from a few seconds to an hour or more due to the shifting of railway loads. The investigation shows that the corrosion under such conditions is much less than has generally been supposed. A copy of the paper may be obtained free by those interested in the subject by addressing a request to the Bureau.

ELECTROLYSIS SURVEYS.—The Bureau of Standards, Washington, D. C., has issued technologic paper No. 28, entitled "Methods of Making Electrolysis Surveys." This deals with the methods of procedure to be followed in examining underground pipes and cables and the return systems of electric railways in order to determine the liability of the pipes and cables to damage from stray electric currents from the railways. The various classes of electrical measurements are described and methods of procedure are outlined in some detail. The selection of instruments for making such tests is treated, and some of the more important considerations involved in the interpretation of the results of electrolysis surveys are discussed. A copy of this paper may be obtained free by those interested by addressing a request to the Bureau.

DEPARTMENT OF GAS AND ELECTRICITY, CHICAGO.—The nineteenth annual report of the Department of Gas and Electricity, City of Chicago, covering the activities of this branch of the municipal government during the calendar year, 1915, has been issued as a 96-page book. The bulk of the report deals with the city's street-lighting system, which on December 31, 1915, comprised the following: Flame arcs, 9,436; 12,271 600-candlepower tungsten lamps; 100 250-candlepower tungstens; 7,509 100-candlepower tungstens and 63 6.6-ampere inclosed arcs. There were also rented 1,324 flame arcs, 12 magnetic arcs, and 47 40-watt tungsten lamps. There were also in use about 10,500 gas lamps and 4,700 gasoline lamps. The report describes the construction work carried on for various electrical purposes, gives data on electrical inspections, fires and accidents, fire-alarm service, etc.

Electrical Patents Issued October 3, 1916

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,199,750. Electrical Protective Device. B. S. Aikman, assignor to National Brake & Electric Co., Milwaukee, Wis. Contacts for cutting out motor controlled by fuse subjected to heat of windings.

1,199,767. Light-Ray-Diffuser Shade for Lamps. F. J. Dole, New York, N. Y., assignor of one-half to H. D. Penney, Pelham, N. Y. To illuminate without glare.

1,199,783. Lockout for Party Lines or Extension Telephones. O. D. M. Guthe, assignor to Western Electric Co., New York, N. Y. Operation of individual relay at any station locks out other stations.

1,199,788. Telephone Exchange System. E. E. Hinrichsen, assignor to Western Electric Co. Arrangement of link circuits in manual exchange.

1,199,789. Electrical Conductor. M. Hochstadter, Harrisburg, Pa. High-tension cable free from sparking and glowing.

1,199,792. Electropneumatic Organ-Valve. R. Hope-Jones, North Tonawanda, N. Y. Structural details.

1,199,797. Conduit for Passenger-Car Electrical Wiring. J. G. Lawler, assignor to American Car & Foundry Co., St. Louis, Mo. Special car-roof structure.

1,199,810. Stamp-Affixing Device. H. A. Mount, assignor to G. L. Sperry, Washington, D. C. Electromagnetic affixer and motor moving stamp strip controlled through perforations in strip.

1,199,816. Tank Car. A. E. Ostrander, assignor to American Car & Foundry Co. Structure of insulated tank.

1,199,829. Battery Meter. W. M. Scott and R. E. Tresise, assignors to Sterling Mfg. Co., Cleveland, O. Has formed-up, integral frame comprising a spool and supports for the pointer and magnet.

1,199,831. Switch-Operating Mechanism. C. W. Squires, Beverly, Mass. Trolley-operated.

1,199,843. Circuit-Closer. R. A. Washburn, Mason City, Iowa. Details of multiple-contact, push-button-operated device.

1,199,846. Storage-Battery Case. G. Wheat, Philadelphia, Pa. Has special provision for securing conductor cord.

1,199,852. Electric Circuit-Controlling Device. A. C. Wyman, Newton, Mass. Has stationary part responsive to vibrations.

1,199,866. Automatic Electric Train-Line Coupling. T. R. Brown, assignor to Westinghouse Air Brake Co., Wilmerding, Pa. Comprises a movable connector for the fixed contacts operated by a mechanical trip device.

1,199,867. Automobile Tail-Light Indicator. W. C. Brown, Fostoria, O. Details of fluid-pressure-operated contact device.

1,199,916. Device for Operating Electrostatic High-Voltage Current Generators. E. A. P. Oppen, assignor to Maschinfabrik und Muhlenbauanstalt, G. Luther, Aktiengesellschaft, Brunswick, Germany. Has provision for introducing heated air into casing containing generator.

1,199,921. Lifting Magnet. G. H. Poth, Cincinnati, O. Exerts endwise thrust on shaft.

1,199,923. Controlling Mechanism for Electric Vehicles. F. E. Queeney, assignor to General Electric Co., Schenectady, N. Y. Has service and emergency brakes interlocked with motor controller.

1,199,924. Dumping Truck. F. E. Queeney, assignor to General Vehicle Co., Inc., New York, N. Y. Control of motor for raising and lowering body.

1,199,925. Truck. F. E. Queeney, assignor to General Vehicle Co., Inc. Mounting and gearing of motor.

1,199,927. Ceiling-Light Structure. F. H. Robinson, assignor to National Spinning & Stamping Co., New York, N. Y. Details of canopy and shareholder secured to socket.

1,199,934. Tone-Producing Means. M. L. Severy, Arlington Heights, Mass., and G. B. Sinclair, Georgetown, Me. Structure of generator delivering pulsations to electromagnet acting on sonorous body.

1,199,936. Overload Protective Device. A. Simon, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. For motor circuits; more sensitive on initial circuit closure than after certain time interval.

1,199,947. Magnetic Chuck. O. S. Walker and I. Fowler Williams, assignors to O. S. Walker Co., Worcester, Mass. Face has two sections of opposite polarity, one a central plate and the other a surrounding ring, separated by gap of non-magnetic material.

1,199,972. Pole Arm. C. G. Ette, assignor to St. Louis Malleable Casting Co., St. Louis, Mo. Extends above pole top.

(See cut, next page.)

1,199,975. Solenoid. B. L. Fernow, Jr., assignor to Cutler-Hammer Co., Milwaukee, Wis. Details of magnetic circuit of electromagnet with reciprocating plunger.

1,199,985. Circuit-Controller. A. J. Hor-

ton, assignor to Cutler-Hammer Mfg. Co. Interlocked knife-switches.

1,199,990. Track Instrument. J. N. Johnson, Albuquerque, N. Mex. Car-wheel-operated contact mechanism.

1,199,991 and 1,199,992. Electric Snap-Switch. O. E. Kenney, assignor to Yost Electric Mfg. Co., Toledo, O. Details of cam members for lamp-socket switches.

1,200,004. Telegraph Key. M. H. Meeker, Council Bluffs, Iowa. Has special spring contact on key lever.

1,200,017. Induction Coil and Related Parts. G. Parker, Foxboro, Mass. For ignition systems.

1,200,025. Process of Recovering Metals. C. J. Reed, Glenside, Pa. For recovering metals electropositive to mercury from an aqueous solution.

1,200,038. Signaling Mechanism. F. O. Singer, assignor to Omega Electric Co., Chicago, Ill. Details of selective contact device.

1,200,040. Electric Lamp. J. B. Speed, assignor to Western Electric Co. Incandescent lamp has light-storing material in the stem. (See cut.)

1,200,041. Method of Insulating Conductors. J. B. Speed, assignor to Western Electric Co. Insulating compound is coated with mica particles.

1,200,063. Electric Condenser. E. B. Wheeler and M. Sultzer, assignors to Western Electric Co. Special metal sheets alternating with plates of insulation and variable pressure device for adjusting capacity.

1,200,074. Combination Electric Switch. O. H. Bloomquist, Crooks, Iowa. Secret combination switch.

1,200,081. Telephone Exchange System. H. P. Clausen, assignor to Western Electric Co. Arrangement of link circuits and signals.

1,200,082. Telephone Transmission System. E. H. Colpitts, assignor to Western Electric Co. Has a loaded line and a repeater with a moving system whose natural period is greater than the cut-off frequency of the loaded line.

1,200,095. Selectively Operated Circuit-Controlling Device. J. C. Field, assignor to Western Electric Co. Details of electromagnetic step-by-step device operated by alternating current.

1,200,101. Electrical Control System for Locomotives. G. B. Gray, assignor to Automatic Train Control & Signal Co., Pittsburgh, Pa. Arrangement of circuits on train for controlling signals and train-controlling means.

1,200,105. Electrically Operated Typewriter. E. Hausbers, Charles City, Iowa. Selective magnets connect type bars with armature of power magnet.

1,200,122. Method and Apparatus for Eliminating Moisture from Evacuated Spaces. A. J. Liebman, assignor to Independent Lamp & Wire Co., Weehawaken, N. J. For freeing incandescent lamp bulbs from moisture.

1,200,142. Stop Mechanism. W. H. Schoonmaker, Montclair, N. J. For phonographs; magnetic device.

1,200,143. Adjustable Insulated Coupling for Motors and Dynamos. A. V. Schrade, New York, N. Y. Details of shaft coupling.

1,200,153. Circuit-Controller for Smoke and Fire-Detecting Devices. J. Warshawsky, Jersey City, N. J., and A. Rodack and A. Rodack, New York, N. Y. Alarm circuit controlled by horizontal vane actuated by upward movement of smoke or other heated gas.

1,200,156. Telephone Exchange System. J. L. Wright, assignor to J. R. Garfield, Cleveland, O. Arrangement of stepping magnets and relays for automatic switches.

1,200,165. Method and Apparatus for Sterilizing. C. F. Burgess, Madison, Wis. An immersion device, comprising a hand battery and electrodes, for producing sodium hypochlorite.

1,200,168. Pull-Chain Guide for Electrical Sockets. F. H. Chapman and O. E. Kenney, assignors to Yost Electric Mfg. Co. Details of socket attachment.

1,200,183. Dental Vulcanizer. G. B. Fraley, Liberty, N. Y. Has steam electrically generated, the heat being controlled according to the pressure.

1,200,186. Diplex Typewriting Telegraph. T. V. Giara, New York, N. Y. Operative levers operated mechanically or electromagnetically by keys and electromagnetically independently of the keys.

1,200,210. Transmitter for Etheric or Wireless Telephone Systems. F. H. Millener, Omaha, Neb. Megaphone is connected by tubes with a number of transmitters acting cumulatively on a circuit.

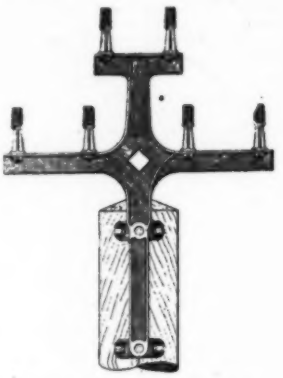
1,200,213. Electric Supply and Control System. J. L. Milton, assignor to Motor Ignition & Devices Co. Engine-ignition system.

1,200,233. Electrical Apparatus. J. S. Preston, assignor to General Electric Co. Coils of a winding are so arranged and connected that the voltages between the pairs of adjacent coils are inversely proportional to their capacities.

1,200,243. Sparking Plug. S. Scognamillo, New York, N. Y. Structural details.

1,200,257 and 1,200,258. Arc Lamp. C. P. Steinmetz, assignor to General Electric Co. First patent: Method of starting alternating-current lamp having an insulating film between the electrodes. Second patent: Modification.

1,200,264. Electrically Operated Hoist. F. L. Stone, assignor to General Electric Co. Has means for automatically gradually



No. 1,199,972.—Pole-Arm.

varying the speed of the motor between certain points in the hoist travel.

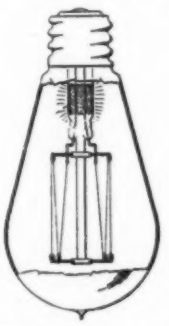
1,200,267. Lock for Automobile Hoods. A. P. Sunnergren, assignor to Motors Lock Co., Pittsburgh, Pa. Electromagnetically operated.

1,200,270. Automatic Car-Stop. A. Taurman, Richmond, Va. Brakes on an electric car are automatically applied on approaching a danger point unless manually prevented.

1,200,277. Automatic Switching Operator's Telephone. R. I. Utter, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Link circuits are divided into groups and an operator's instrument may be connected with any one of the groups.

1,200,294. Insulator. W. G. Ayer, Baker, and F. L. Shaw, Durkee, Ore. Slotted knob with shoulder for retaining the wire in the slot.

1,200,310. Motor-Control System. F. E. Case, assignor to General Electric Co. Controller retarder permits rapid return to



No. 1,200,040.—Electric Lamp.

running position after it has just been moved to off position.

1,200,312. Dynamoelectric Machine. E. R. Clarke, London, England. For producing continuous electrical oscillations.

1,200,317. Electric-Cable Coupling. C. T. Crocker, assignor to General Electric Co. Has pawl arrangement for forcing the parts together.

1,200,319. Switchboard Cord. H. D. Currier, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Structure and arrangement of strands.

1,200,320. Magneto. R. C. Danley, Chicago, Ill. Has oscillating armature spring operated in one direction.

1,200,325. Method of Regulating and Proportioning the Feed of Dry or Granular Chemicals in Water Mains. G. G. Earl and A. B. Wood, New Orleans La. Has electromagnetic control.

1,200,327. Speed-Controlling Device for Ring-Spinning Frames. F. Eichberg and H. Blake, assignors to General Electric Co. Thread tension is regulated by controlling speed of electric driving motor.

1,200,339. Automatic Stop for Trains. C. J. Graham and J. A. Farris, assignors of one-third to J. Wilgus and P. Wilgus, Chicago, Ill. Brake solenoid is operated and motor circuit opened when truck leaves the track.

1,200,340. Game Apparatus. S. G. Greenwood, Indianapolis, Ind. Circuit of indicator is closed when metal punch is inserted in one of perforations of a punch board.

1,200,342. Trolley Retriever. J. E. Gundry, Flint, Mich. Details of centrifugally controlled, spring-operated drum.

1,200,345. Separator for Secondary Batteries. F. W. Hardy and E. H. Hungerbuhler, Saltburn, England. Thin plate of baked, compressed, dry-powdered aluminum silicate and powdered silica.

1,200,352. Electric Resister. W. S. Hadaway, Jr., New York, N. Y. Flexible structure comprising wire in casing and insulated therefrom by compound of silica and aluminum.

1,200,366. Battery Lamp. J. F. Kerlin, assignor to National Carbon Co., Cleveland, O. Lamp and reflector in end seal of battery.

1,200,368. Protecting Tube for Telephone-Cord Outlets. J. M. Klug, Novelty, O. Prevents cutting of cord at entrance to receiver or transmitter.

1,200,375. Electromagnetic Valve. T. J. Litue, Jr., assignor to Welsbach Light Co., Gloucester, N. J. Gas valve with operating magnet.

1,200,378. Thermo-Alarm. C. R. Lumley, Seattle, Wash. Circuit-closer controlled by thermal, linear-tensioned, resilient member.

1,200,398. Light Reflector. O. S. Strom, Los Angeles, Cal. Details of lamp-supporting fixture having reflector permitting direct diffusion of light substantially horizontally.

1,200,403. Holder for Electric Flashlights. N. Weyer, Lewiston, Minn. For securing to the arm of the user.

1,200,404. Apparatus for Raising Sunken Vessels and Other Bodies. J. W. White, Widnes, England. Arrangement of lifting magnets.

1,200,412. Wireless Control System. M. Compare, Leghorn, Italy. Employs a number of oscillators of different vibration periods.

1,200,444. Electromagnetic Air-Brake. E. R. Humphrey, assignor to Safety Air Brake Co., Victoria, British Columbia, Canada. Electromagnetic attachment for triple valve for applying and releasing the brakes with the valve in release position.

Reissue 14,197. Igniter for Internal-Combustion Engines. E. G. Wayman, assignor to Wayman-Aiken Electric & Mfg. Co., Wilkinsburg, Pa. Original No. 1,185,030. Filed Aug. 22, 1916. Has pressure-operated movable electrodes.

PATENTS EXPIRED.

The following United States electrical patents expired on October 10, 1916:

634,467. Electrical Influence Machine. K. S. Lemstrom, Helsingfors, Finland.

634,487 and 634,488. Electrical Indicator. M. Waddell, New York, N. Y.

634,541. Electric Starting Device for Gas Engines. J. W. Raymond, Oil City, Pa.

634,542. Electric-Lighting Apparatus for Railway Cars. W. F. Richards, Buffalo, N. Y.

634,568. Insulating Support for Electric Wires. C. N. Beal, San Francisco, Cal.

634,575. Telephone System. E. W. Ham, Worcester, Mass.

634,623. Conduit Railway. M. D. Law, New York, N. Y.

634,666. Electric Brake. G. H. B. Hooper, Toronto, Canada.

634,667. Electromagnetic Cylinder Engine. G. H. B. Hooper, Toronto, Canada.

634,744. Valve-Operating Device and Alarm. A. Borden, St. Louis, Mo.

634,759. Crossing for Underground Conduits for Electrical Conductors. V. Koch, Scranton, Pa.

634,766. Electrical Binding Post. W. Roche, Jersey City, N. J.

634,767. Volt and Ampere Meter. J. D. Ross, Victoria, Canada.

634,804. Brushholder for Commutators. W. Cooper, W. H. Warren and C. A. Mudge, Cincinnati, O.

634,811. Electric Meter. P. Eibig, Berlin, Germany.

634,816. Electric Block-Signal System. S. H. Hall, Buffalo, N. Y.

634,832. Brake and Power Apparatus for Electrically Driven Vehicles. W. E. Pearson, Boston, Mass.

634,848. Device for Preventing Electrolysis in Pipes. C. S. Courson, Springfield, O.

634,849. Arc Lamp. J. A. Davis, Cleveland, O.